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Exploratory High Elevation Regeneration Trials in the Vancouver Forest Region: 10-Year Species Performance of Planted Stock

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Exploratory High Elevation Regeneration Trials in the Vancouver Forest Region: 10-Year Species Performance of Planted Stock

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ABSTRACT

Clearcut logging followed by slashburning and planting of bareroot Douglas-fir used to be a common practice at high elevations on the British Columbia coast.

Chronic plantation failure prompted foresters to look for alternative species and stocktypes, and these became available in the mid-1970's. Ten-year results of a wide range of planted stocktypes and species are reported here. High elevation species had better survival and form than low elevation species and displayed the least variation in performance. In particular, noble fir, amabilis fir, and Engelmann spruce showed consistent form and good growth.

ACKNOWLEDGEMENTS

Helmar von Hahn provided the initiative to establish and monitor these plantations, and helped track down errant trees. Without his enthusiasm this project would not have been possible. George Krumlik initiated the remeasurement and suggested the authors seek FRDA support. George Shishkov and Paul Courtin helped collect data and set the plantations out for extension and demonstration. The project was funded jointly by the provincial and federal governments under the Canada-British Columbia Forest Resource Development Agreement (FRDA 2.24).

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1 INTRODUCTION

Through the 1960's and early 1970's, silvicultural practice on high elevation sites[1] followed prescriptions derived from low elevation experience. Clearcut logging was frequently followed by slashburning and the planting of bareroot Douglas-fir (Utzig and Herring 1975). These plantations suffered high rates of mortality. Trees that survived exhibited deformed stems and other physical damage. Errors in species prescription, site preparation, and planting time were suspected. A primary problem was the failure to match species to ecological conditions.

With the first cone collections of many subalpine tree species and the advent of large-scale production of container-grown seedlings in the mid-1970's, a wider variety of stocktypes and species became available for regeneration. These included *Abies amabilis* (Ba),[2] *Abies lasiocarpa* (Bl), *Abies procera* (Bn), *Chamaecyparis nootkatensis* (Yc), and *Tsuga mertensiana* (Hm). Exploratory trials using the first stock produced from these different species and stocktypes were established to examine the stock reliability, productivity, and feasibility under high elevation conditions. The trials subsequently influenced various changes made to regeneration practices in the 1970's. This report documents these trials and their results.

1.1 Objectives

The initial objective of the original experiment was to get short-term information on the survival and early performance of several new species and stocktypes being produced for high elevation sites.

The aim of remeasurement was to examine the longer-term performance of these species and stocktypes. Emphasis was placed on form description and performance variability, as well as on survival and growth. Form has been recognized as an important factor in assessing plantations. Carter and Klinka (1986) have described form defects in low elevation plantations of Douglas-fir; and other researchers have noted form defects in various high elevation plantations (Williams 1966; Leaphart *et al.* 1972).

1.2 Locations

Backlog and recently harvested sites were initially selected for the trials (Figure 1, Table 1, Appendix 1, 2). The four locations chosen are typical of reforestation sites in the mid-1970's for the higher elevations of the coast Mainland. Chipmunk Creek was the first area above 1200 m that was logged and slashburned. All locations were ecologically described (Appendix 1). Maps of the locations, noting the ecosystems, are provided in Appendix 1. Ecological site descriptions are provided in Appendix 2.

In this report, the term "location" refers to a specific experimental plantation. The more general term "site" refers to a plantation environment (e.g., "high elevation site").

1.3 Report Use and Limitations

This study used species and stocktypes that were new to reforestation in the mid-1970's. Since the experiment was established, stocktypes as well as nursery and silvicultural practices have changed, and stock now available may perform differently from that used in the study. Furthermore, the results from these research plantations may differ from those achieved in an operational experience.

These trials are not intended to provide a definitive statement on stocktype suitability for high elevations, but to represent the range of species performances encountered on high elevation sites. More formal trials have been established to examine species and stocktype suitability (Arnott and Pendl 1982). A brief, illustrated summary of this report is contained in Scagel *et al.* (1988). Appendix 1 and 2 are provided to serve as a self-guiding tour of the research locations.

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1 High elevation sites are defined as those found above 900 m on Vancouver Island (MHa) to above 1350 m in the Coast-Interior Transition (ESSFf).

2 Abbreviations given parenthetically are used throughout the report.

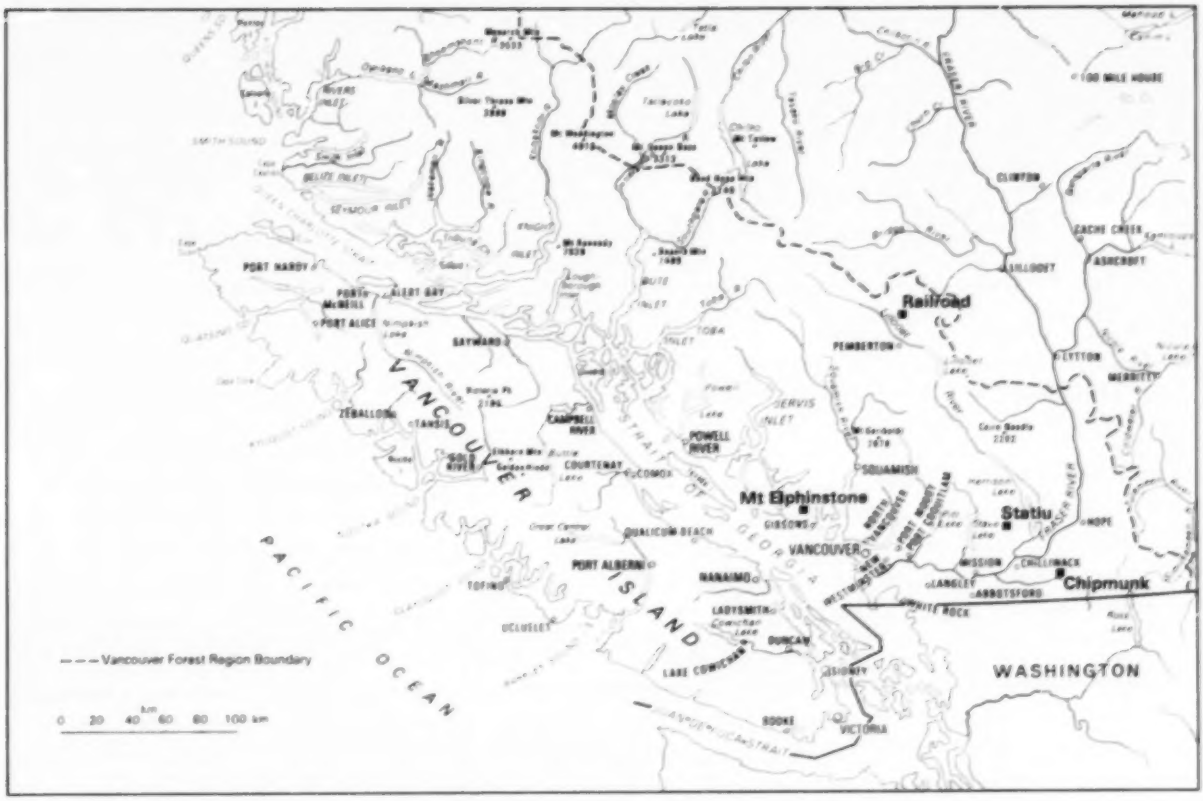

FIGURE 1. Plantation locations. The four plantation locations studied are all on the British Columbia coast mainland.

TABLE 1. Plot locations

Location	Elevation (m)	Biogeoclimatic Subzone[a]	Logged	Burned
Mt. Elphinstone	1030	MHa	1963	1963
Statlu Creek	1050	MHa	1972	1975
Railroad Creek	1100	MHb5	1975	1976
Chipmunk Creek	1200	CWHb5	1959	1960

[a] Klinka *et al.* (1984)

2 APPROACH

2.1 Establishment

The four locations were planted in the spring and fall of 1976 and 1977 with a wide range of available species and stocktypes. Species included six typically high elevation species (Krajina *et al.* 1982): Hm, Bn, Yc, Ba, Bl, and Se. Five low elevation species (Krajina *et al.* 1982) were also used: Douglas-fir (Fc), western hemlock (Hw), western redcedar (Cw), western larch (Lw), and lodgepole pine (Pl). Trees were planted 25 to a row by a single planter. Planting sites were carefully selected to provide the best available conditions for planting and protection from anticipated heavy snowpack. All rows were staked and mapped. Species, stocktypes, seedlots, and planting seasons are shown in Appendix 1.

2.2 Evaluation Strategy

Klinka and Feller (1984) proposed that tree species selection for regeneration be based on three general criteria: reliability, productivity, and feasibility.

The evaluation of the species and stocktypes used in high elevation plantations in this study focuses on the stock's silvicultural reliability and productivity.

How reliable will a potential species and stocktype be on a site?

Reliability encompasses survival, continued growth, and acceptable form, under the expected range of environmental and biological hazards that a stand experiences through a rotation. Because the high elevation environment is so extreme and rotations are so long, reliability of stock is a particularly important consideration.

How productive will a potential species and stocktype be on a site?

High silvicultural reliability is not always accompanied by high productivity. When trade-offs between reliability and productivity occur, they must be evaluated on a site-by-site basis.

How feasible is the stock for the site?

Stock may potentially have high reliability and high productivity, but the cost of achieving these may not be realistic. The feasibility of establishing a crop depends on what is regarded as economic under a particular management strategy.

2.3 Measurements

In the fall of 1986 and 1987, all surviving trees were measured for: total height; 10th-year height increment (leader length); diameter at 30 cm; and length of maximum lateral branch. Total height and diameter reflect the cumulative productivity up to the 10th year. The length of the 10th year height increment indicates how vigorously the tree is currently growing. The length of the maximum lateral branch provides an estimate of the radius of projected crown area. This area can be thought of as a surface area for the collection of snow. The larger the crown area, the larger the potential weight of the snowpack pressing onto the tree (assuming the stem is erect).

Form variables were described in terms of their presence or absence for individual trees. The variables noted were: frost damage; stem forking; stem sinuosity or sweep; multiple leaders; and stem breakage. These assessments of form, which are admittedly subjective, are illustrated by example in Scagel *et al.* (1988).

3 DATA ANALYSIS

The design of this experiment emphasized diversity of species, stocktypes, and plantation environments. This diversity was achieved at the expense of replication. A formal experimental design lacking, data analysis by "exploratory" methods was favoured over statistical significance testing.

All results are presented as box plots, which illustrate the median,[3] range, and spread of 50% of the data points about the median (Figure 2). Forestry applications of box plots are reviewed by Titus (1987). The plots focus attention on central tendency and variability in a set of data, with variability in performance being an important silvicultural consideration (Tunner 1981; Vyse 1981). Stock with low variability (one aspect of high reliability) should produce a more uniform crop than stock with high variability.

The evaluation of these trials did not use the Ministry of Forests' current free-growing criteria. Free-to-grow status was not appropriate because the majority of high elevation species are shade tolerant; stocking standards were not appropriate because of the layout of the experiment. Five criteria for acceptable silvicultural performance were used:

1. mortality of less than 20%.
2. 10-year cumulative height growth of at least 1 m.
3. 10-year diameter of at least 10 mm.
4. 10th-year annual height increments of at least 10 cm.
5. Form deformities on less than 20% of the surviving trees.

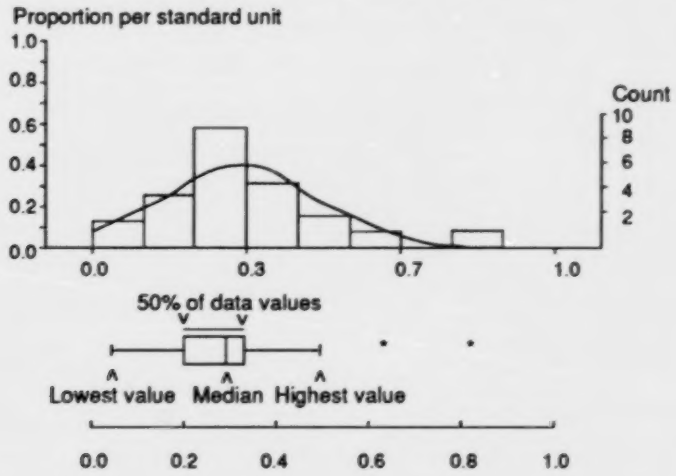

FIGURE 2. What's a box plot? Above is a comparison of a box plot to a histogram. A box plot describes the range, standard deviation, and median for a body of data. It also indicates the distribution of the data about the median. The median divides the data in half. If the data are distributed symmetrically about the mean, the mean and the median will be equal.

In ranking overall species performance, we have assumed that those species displaying the least damage and variability in damage will remain the best performing species. This may not be a valid assumption, as trees may perform differently if they grow above the snowpack, remaining exposed all winter rather than being insulated in the snow.

All data are presented by individual location. Because form variables and survival data are based on their presence or absence, analyses of these are according to row-percentages (25-trees/row) at a location. Growth summaries are based on all trees for each species at a location rather than on row averages. Graphical species summaries, combined over all locations, are provided in Scagel *et al.* (1988).

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[3] The median splits the data in half and is identical to the mean provided the data are normally distributed.

4 RESULTS

4.1 Survival

Differences between species stood out at all locations. Differences between stocktypes, planting times, and seedlots were also notable, but without replication the practical significance of these differences can not be easily evaluated. Only species differences are reported here.

Ten-year survival was highly variable. The most noticeable survival differences were among the species. Survivals at four locations are given in Figure 3. Row survivals for each of the locations are noted in Appendix 1.

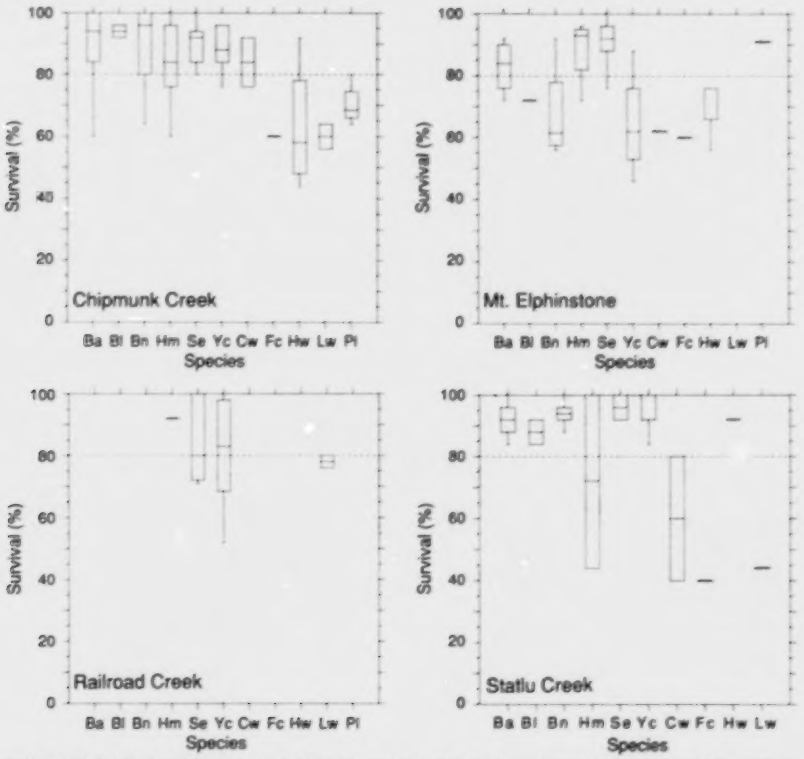

FIGURE 3. Survival of high and low elevation species planted at four high elevation sites. All stocktypes and both planting dates are pooled together. The dashed line represents the lower limit of acceptable survival. Species abbreviations given in text. Box plot graphic convention described in Figure 2. Short horizontal line rather than box indicates a single row value.

The survival results pooled over all locations indicated that:

1. High elevation species generally had higher survival and less variability in survival than the low elevation species. All low elevation species had unacceptable mortality and can be regarded as unreliable.
2. Hm, Bn, and Yc had higher mortality and were more variable than Ba, Bl, and Se. This was attributed to a lack of dormancy in these species at fall planting. Nursery cultural practices have been modified to ensure that this situation no longer occurs.
3. Mortality was increasingly less variable in Ba, Bl, and Se than in other species. Lower variability in survival shows that these species are more predictable and thus more reliable than other high elevation species.
4. Mortality was most severe under the harshest winter climate, at Mt. Elphinstone. In particular, Bn had an unacceptable mortality at this location.
5. Mortality of Se at Railroad Creek was more variable than at other sites, possibly because of severe fireweed press during the early establishment years.

4.2 Growth

The most pronounced growth differences occurred between species. Individual row growth for each location is noted in Appendix 1. The total height, 10th year increment, diameter, and maximum lateral branch length are shown in Figures 4-7.

Where possible, growth was compared across ecosystems. Ecosystems were not strongly associated with growth over the first 10 years. As the stand ages, a stronger relationship may develop.

The initial growth of the high elevation species was not as good as that in the low elevation species, but the annual increment has been increasing. In the years since remeasurement, height growth increment in Bn, Se, and Ba has been averaging over 50 cm/year.

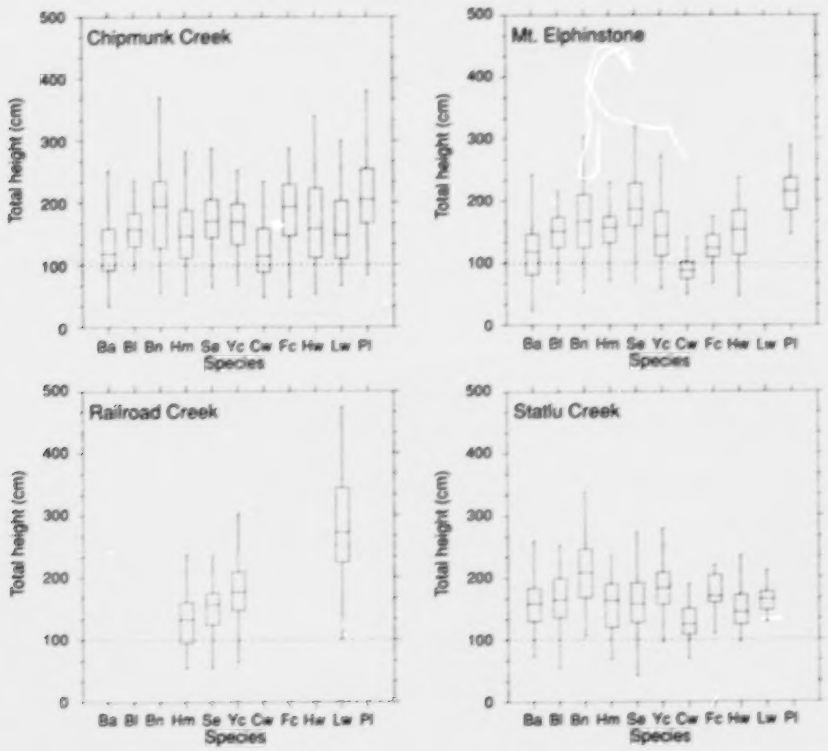

FIGURE 4. Total height of high and low elevation species planted at four high elevation locations. Height measured along the length of the stem regardless of the inclination of the tree. Dashed line indicates lower limit of acceptable height growth.

The growth results indicated that:

1. In contrast to the pattern of survival, high elevation species did not out-grow low elevation species. In particular, the low elevation species, Pl and Lw, were taller but showed greater height growth variability. They should be regarded as less predictable than the high elevation species. The diameter growth of Bn was unsurpassed by any other species.
2. Among the high elevation species, Ba, Bl, and Se exhibited the least variability in growth, suggesting their greater reliability.
3. Except for Yc, the high elevation species had shorter lateral branches than did the low elevation species. Shorter lateral branches decrease the crown area of the seedling and thus the weight of snow it must bear.
4. Wherever it was planted, Cw total height was the poorest of all the species and barely acceptable.
5. For all species, the most severe location, Mt. Elphinstone, exhibited the poorest growth. Generally, the best growth occurred at Railroad Creek.

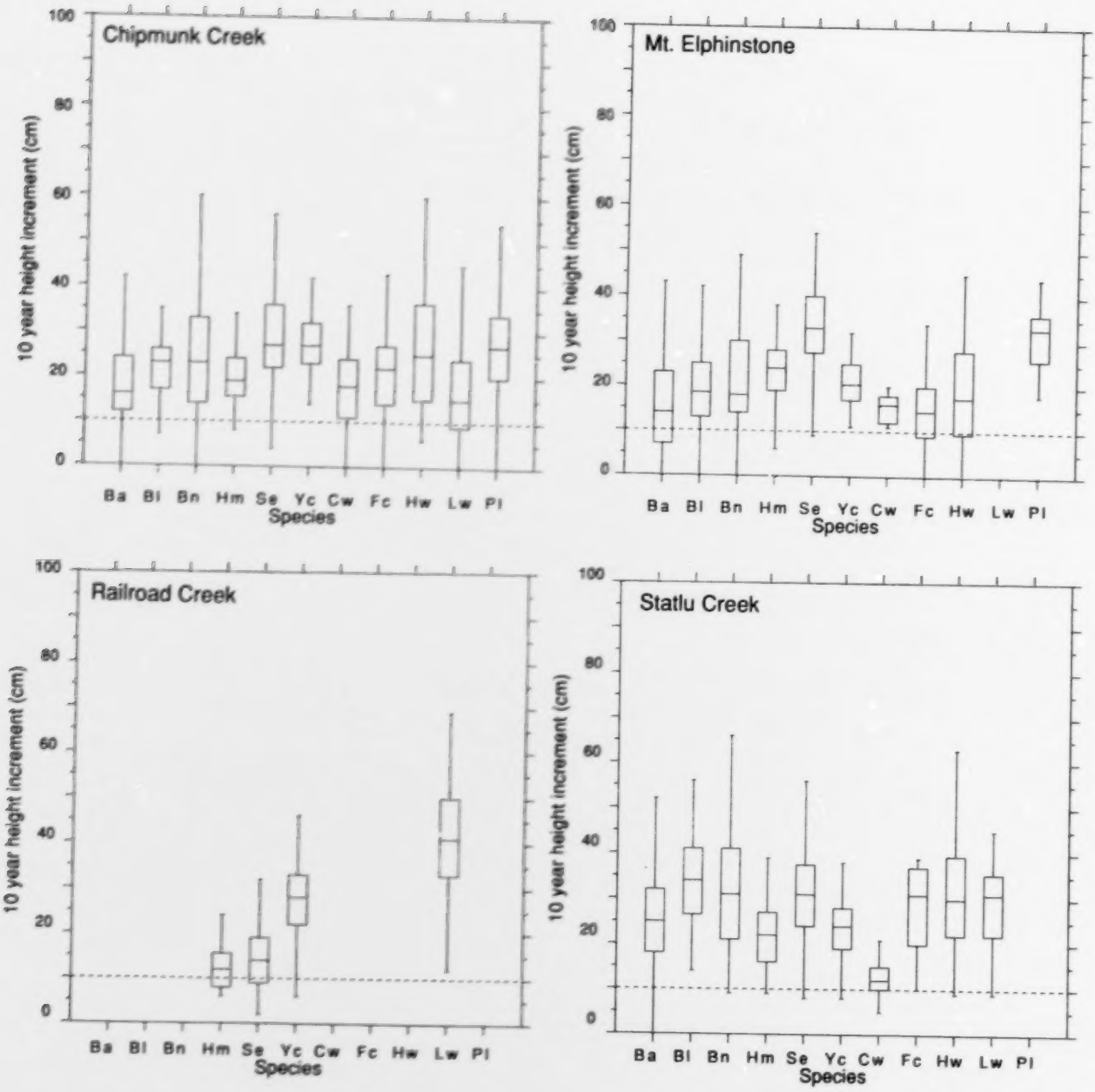

FIGURE 5. Tenth-year height increment of high and low elevation species planted at four high elevation locations. For multiple-leadered trees, the length of the longest leader was measured. Dashed line represents lower limit of acceptable 10th-year height increment.

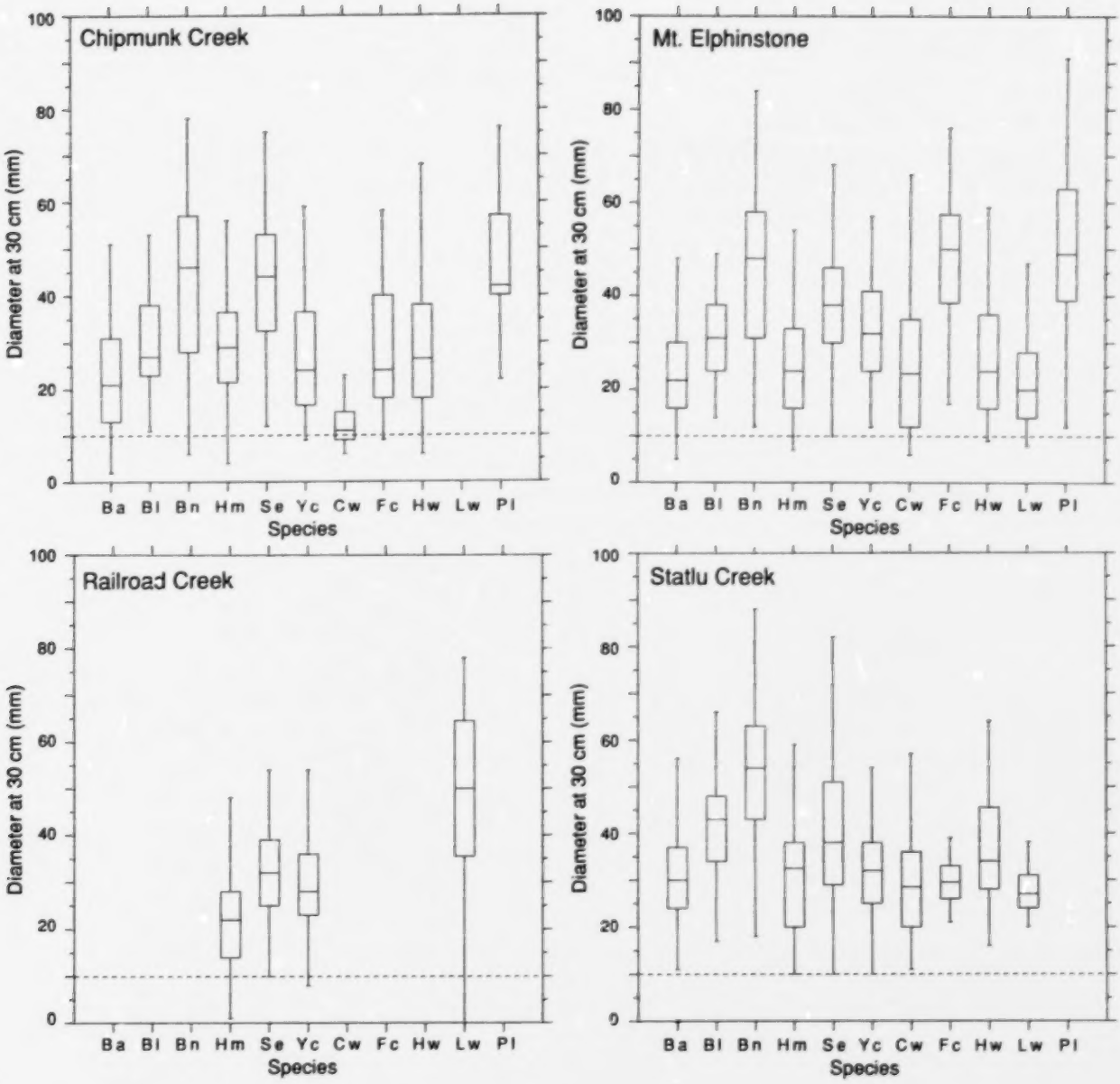

FIGURE 6. Diameter at 30 cm of high and low elevation species planted at four high elevation locations. For multiple-stemmed trees, the largest stem was measured. Dashed line represents the lower limit of acceptable diameter.

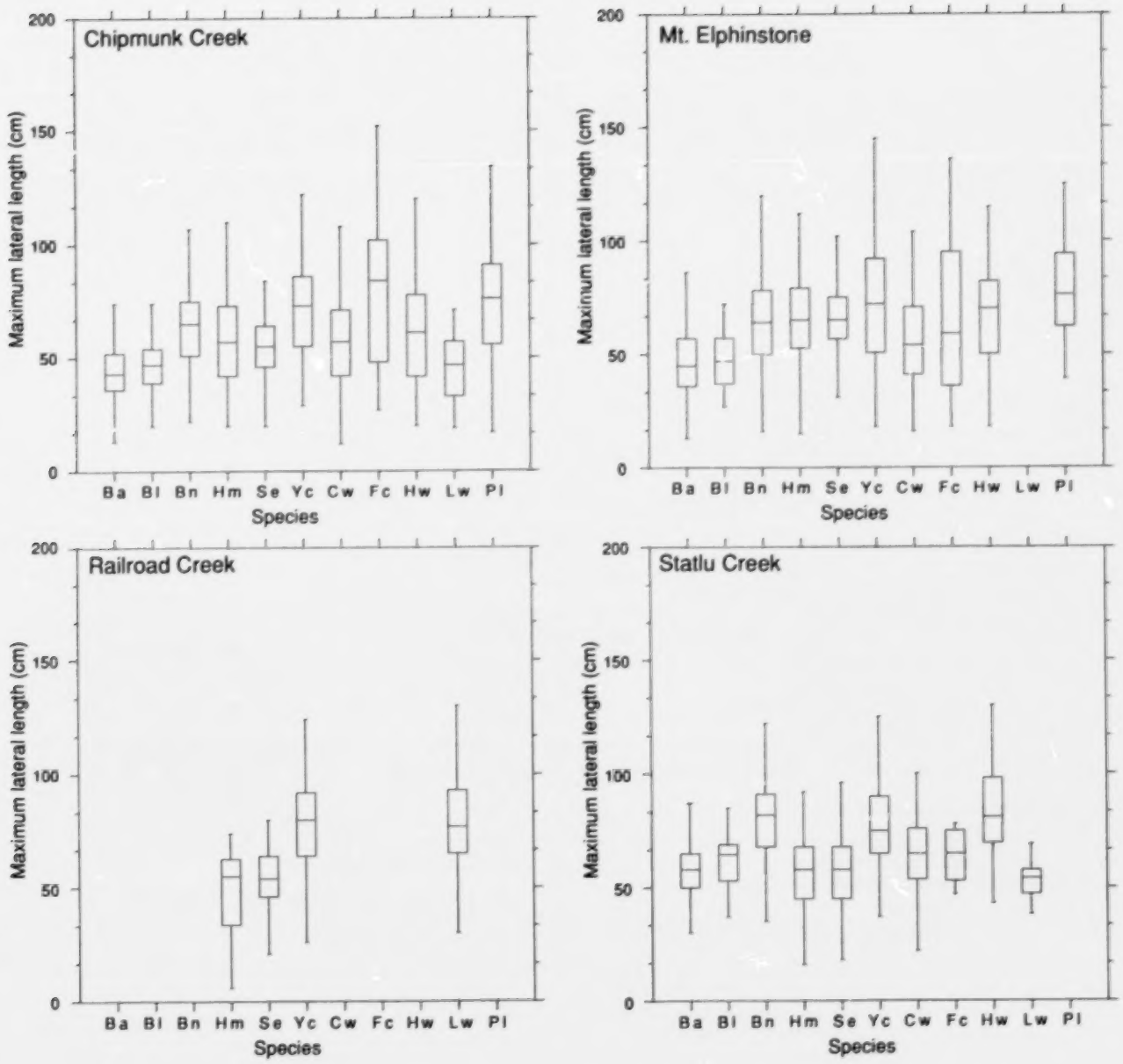

FIGURE 7. Maximum lateral branch length of high and low elevation species planted at four high elevation locations.

4.3 Form

The most striking feature observed in these plantations was the wide variability in form (Fig 8-12). Nearly all trees showed some degree of basal sweep. The incidence of form defects by individual row for each location is noted in Appendix 1. Many species exhibited unacceptable form defects caused by snow, frost, and wind damage. Form was related to local microtopography.

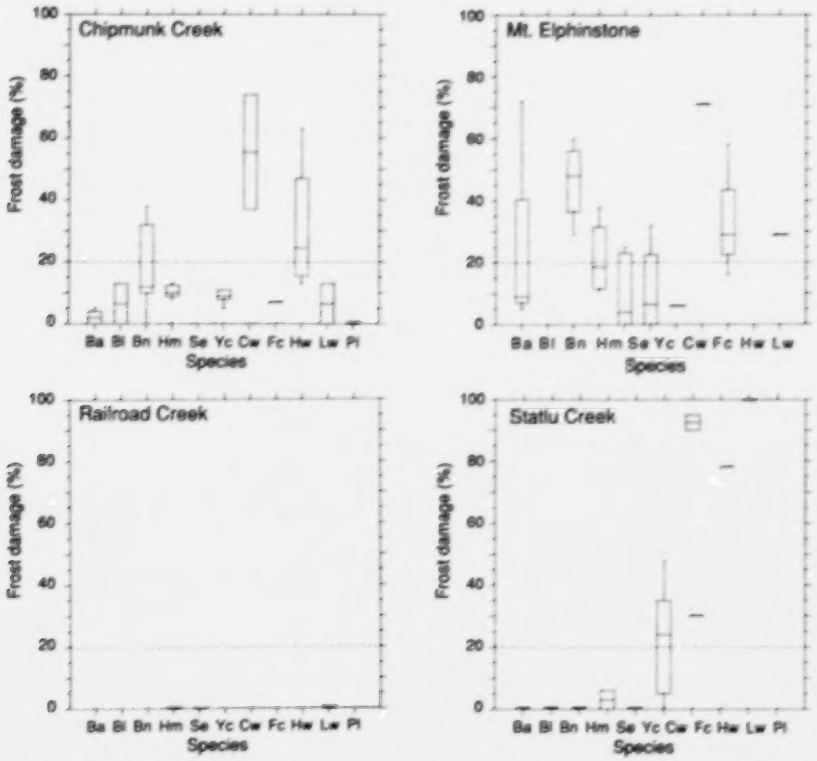

FIGURE 8. Frost incidence of high and low elevation species planted at four high elevation locations. Dashed line represents the upper limit of acceptable incidence.

The form results indicated that:

1. Low elevation species had unacceptable levels of form defects. In particular, Fc showed unacceptable levels of breakage (Figure 12). Generally, Cw and Hw were the most affected by frost, except at Mt. Elphinstone where Cw displayed only slight frost damage because the trees were very small and sheltered by *Vaccinium*. The high elevation species had generally fewer form defects and greater consistency than did low elevation species. In this regard, high elevation species are more reliable than low elevation species.
2. Of the high elevation species, Bn was the most affected by frost damage and displayed the greatest variability of form. Yc also showed frost damage, particularly in the exposed plantation at Mt. Elphinstone. Although a productive species, Bn may not be as reliable as other high elevation species in these conditions.
3. The most severe form defects were observed under the most severe location conditions, Mt. Elphinstone. Lower rates of form defects were noted in the transition locations which experienced lighter snowpacks than the coastal locations.
4. Of the high elevation species, Yc and Hm were the most severely deformed. These species layered readily and had multiple stems and leaders.
5. The most variable of the high elevation species was Yc, particularly in the coastal plantations. Under the lighter snowpacks of the Transition, the species showed improved form — a single, dominant stem rather than a multiple-stemmed, multiple-leadered, layered shrub.

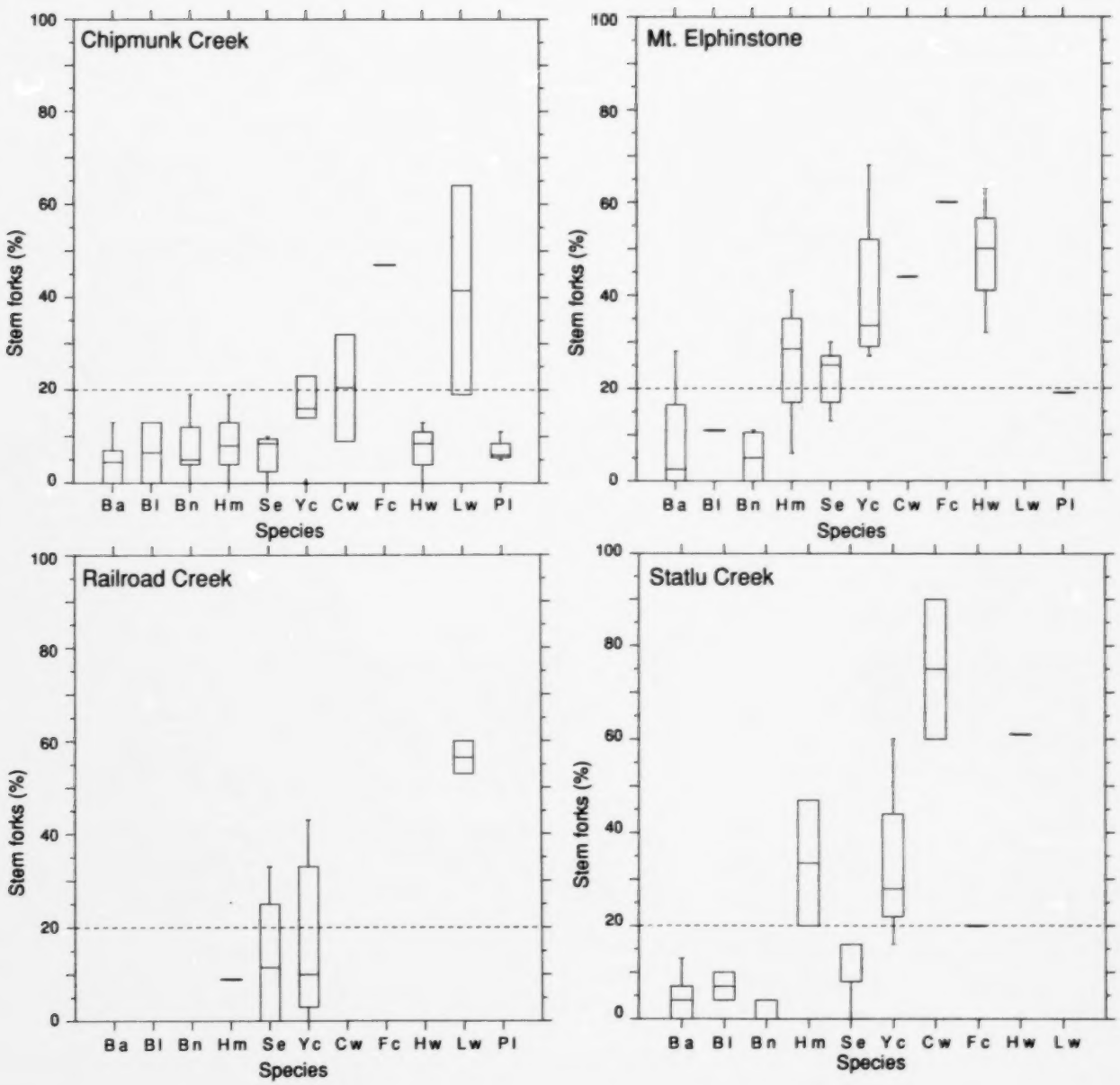

FIGURE 9. Stem fork incidence of high and low elevation species planted at four high elevation locations. Stem forks are noted along the length of the largest stem of multiple-stemmed trees. Dashed line represents the upper limit of acceptable incidence.

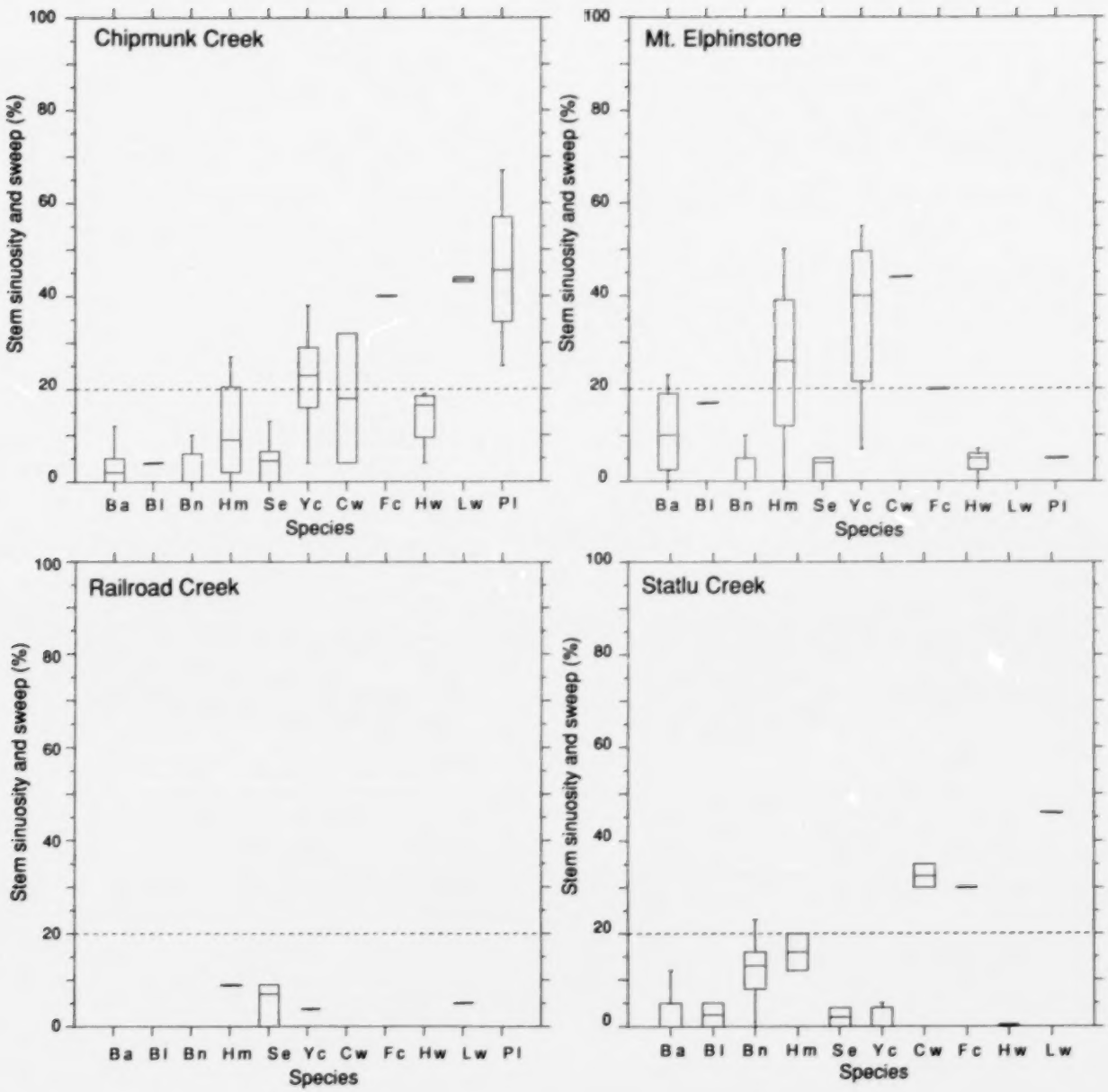

FIGURE 10. Incidence of stem sinuosity and sweep ("hockey stick") of high and low elevation species planted at four high elevation locations. Only severe stem sinuosity is included in this summary. Dashed line represents the upper limit of acceptable incidence.

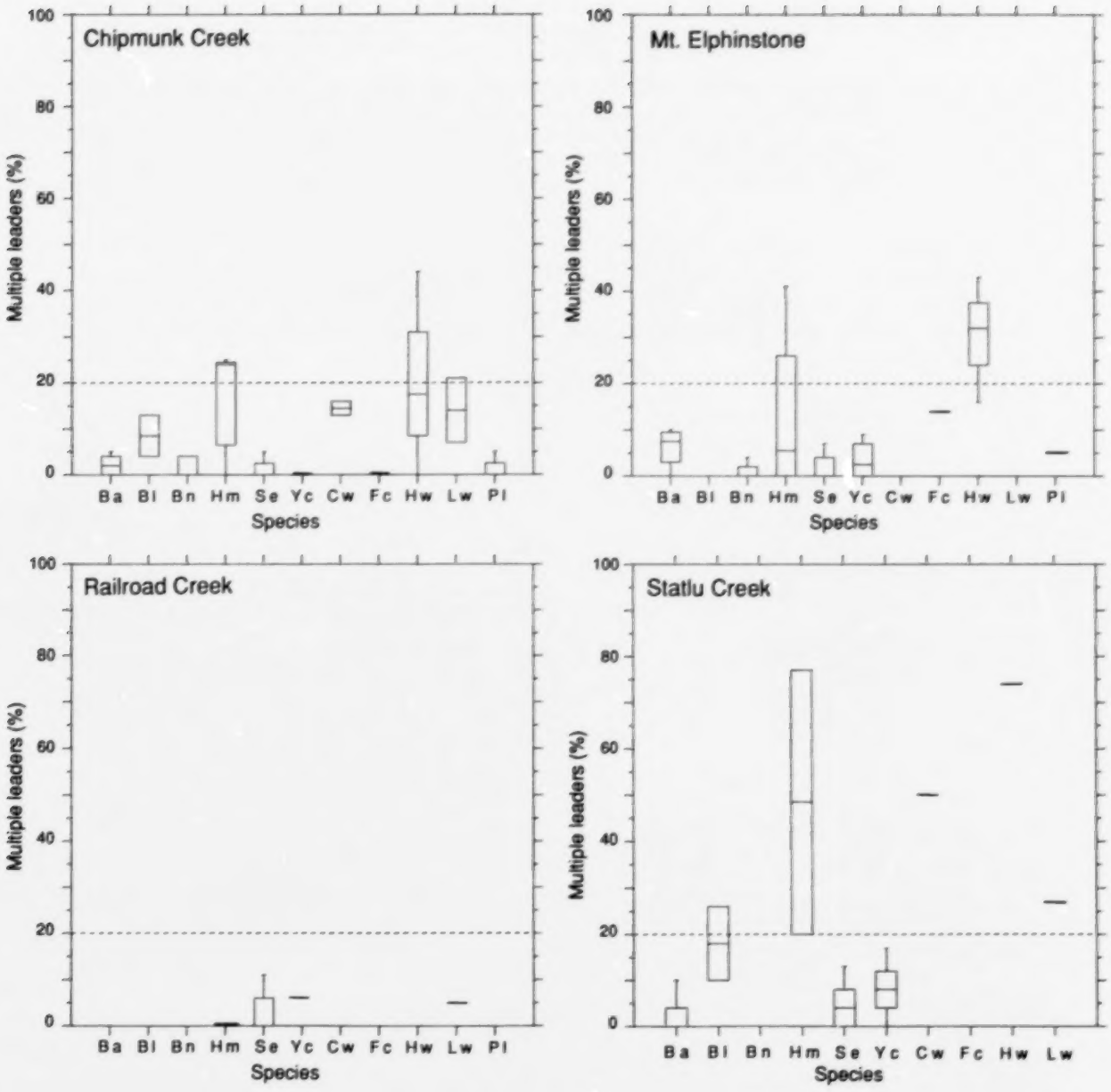

FIGURE 11. Incidence of multiple leaders of high and low elevation species planted at four high elevation locations. Dashed line represents the upper limit of acceptable incidence.

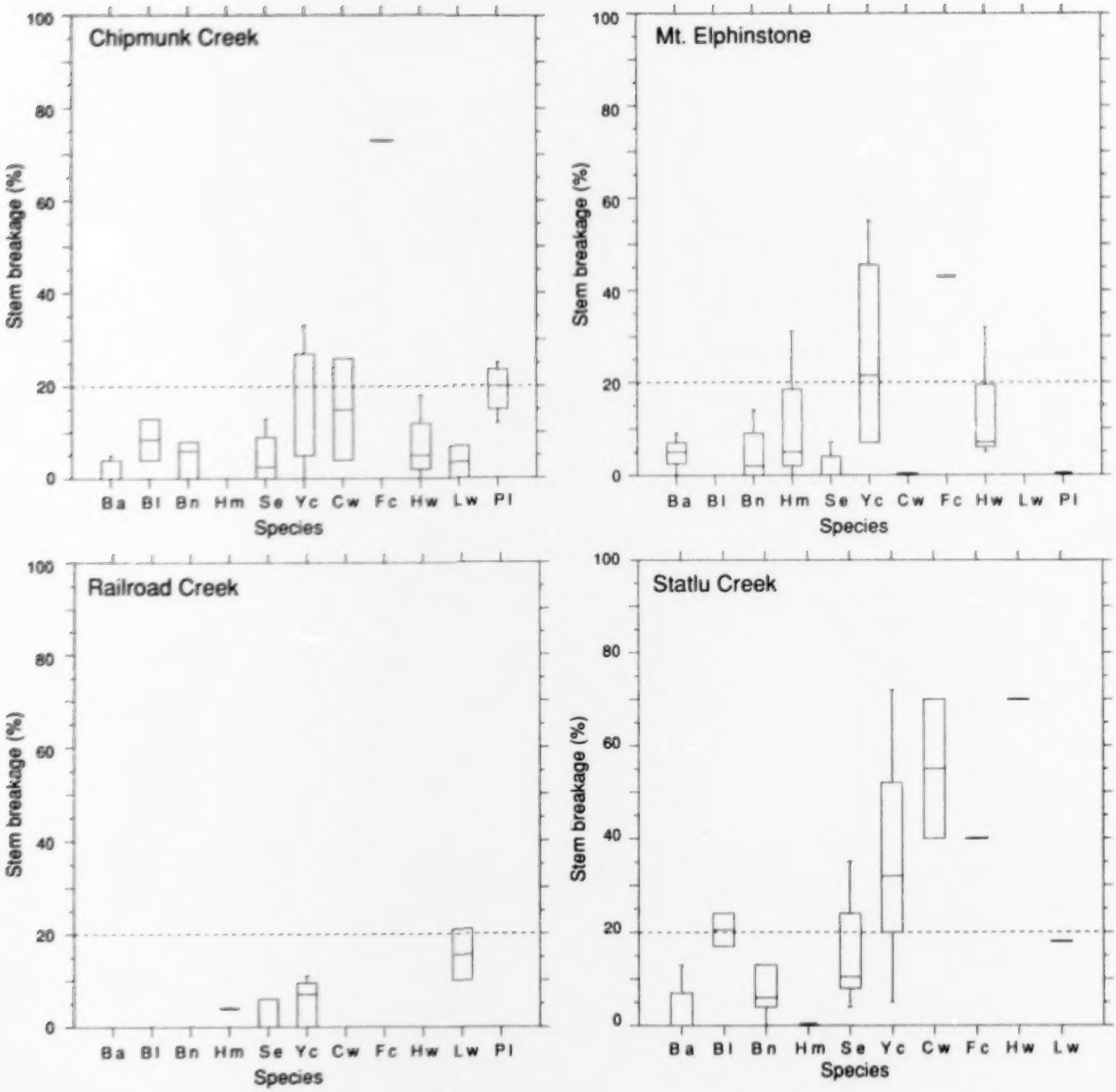

FIGURE 12. Incidence of stem breakage of high and low elevation species planted at four high elevation locations. Stem breakage is distinguished from stem forking by the presence of only a single stem at the point of injury as compared to multiple stems. Dashed line represents the upper limit of acceptable incidence.

5 DISCUSSION

5.1 The High Elevation Environment-Silvicultural Challenge

No single best species or silvicultural strategy can be suggested for regenerating high elevation sites. Their physical environments are notably extreme climatically, and seasonal frosts and persistent, heavy snowpacks damage plantations. Forest openings increase the depth of snow deposition.

The depths and densities of snowpacks for a number of coastal mainland snow courses are given in Table 2. Snowpacks decrease in depth from about 3 to 1.5 m towards the Coast-Interior Transition[4] (B.C. Ministry of Environment 1980). The density of coastal snowpacks is also about double the transition snowpack (B.C. Ministry of Environment 1980). There can be substantial year-to-year differences in snowpacks. Summers are typically cool and wet (Klinka *et al.* 1984) with intermittent warm periods.

TABLE 2. Snowpack measurements. April 1 snow survey data for selected high elevation snow courses (B.C. Ministry of Environment 1980). Data have been pooled over the establishment years for the experiment (1976-1980).

Location	Elevation (m)	Biogeoclimatic Subzone		Snowpack Depth (cm)	Snowpack WE[a] (cm)
"Transition" locations:					
Boston Bar Creek	1230	MHb		202	72
Lightning Lake	1220	ESSFf		90	29
Duffy Lake	1200	MHbxESSFf		116	45
Kiesilkwa	1130	MHb		88	31
Callaghan Creek	1040	MHb		203	88
			Mean	140	53
"Maritime" locations:					
Stave Lake	1210	MHa		332	128
Grouse Mountain	1100	MHa		241	107
Hollyburn Mountain	1100	MHa		319	143
Dog Mountain	1080	MHa		252	107
Seymour Mountain	1070	MHa		296	128
Powell River	1040	MHa		263	97
Loch Lamond	900	CWHb2		242	102
			Mean	274	115

[a] WE = water equivalent (determined from weight of snow core); index of snow density.

We expect that larger trees with wider, spreading branches will bear more snow than smaller, narrower trees. For example, narrow-crowned Ba would not be above the snowpack after 10 years and would support about 200 kg of snow in the Transition versus 950 kg of snow under the coastal climate. The species Fc has a much larger crown and would have to bear nearly double the snow of Ba.

The four locations show a wide range of snow conditions and winter climates. Topography and vegetation influence the deposition and movement of snow (Megahan and Steele 1988) and the occurrence of frost. For example, grass swards provide a smooth plane for snow to glide over, crippling seedlings in the process. Shrub thickets are more effective at anchoring the snow, preventing both glide (movement of the entire snowpack) and creep (deformation within the snowpack) as well as distributing the weight of the snowpack.

[4] Transition climates refer to submaritime and subcontinental climates that occur between the maritime climates of the Coast and the continental climate of the Interior.

The effects of snow movement on regeneration must be considered on a site-specific basis. The potential for snow movement (creep and glide) increases with snowpack depth and density, the slope gradient, and slope aspect. High-weight snowpacks deform more than low-weight snowpacks. Snow movement decreases with increased surface roughness (Megahan and Steele 1987). Intentionally planting seedlings downslope of stumps may ameliorate this aspect of the climate.

The physical severity of the cutblock environment will be influenced by the orientation of the block to prevailing winds and by the macrotopography. For example, ridge crests (such as those on Mt. Elphinstone) are more exposed to high winds and ice abrasion. Swales and flats are subject to increased snow deposition through drifting. The resultant late snowmelt effectively shortens the growing season.

In the development of regeneration strategies, expectations of performance should be tempered by a consideration of the frequency of performance-limiting, climatic events. Infrequent events such as ice storms may be as debilitating to performance as annual frosts. General climatic events can be anticipated if the forester consults records from high elevation climate stations and snow courses.[5] Damage to vegetation in the actual location should also be noted.

Winter events have a major effect on seedling form. Seedling morphology can be modified by frost, wind, snowpack movement, and the water content of snow. Branch geometry, leaf area and size, and the flexibility of stem and branches control the susceptibility of seedlings to snow damage. The reliability of a species for high elevation regeneration will depend on its resistance to winter damage.

5.2 Considerations in Assessing Regeneration Performance

Assessment of high elevation plantation performance must be based on more than survival and growth. Form must be considered. Sites can be fully stocked and free growing, yet still exhibit poor form. Douglas-fir, for example, produces lots of biomass but has poor survival and is subject to severe stem and branch breakage. "Free growing" may not be a particularly satisfactory regeneration criterion for high elevations anyway, as most successful high elevation species are shade tolerant. Brush development, which would be considered a problem in a Douglas-fir plantation, could be easily tolerated by high elevation species. On many high elevation sites, brush may actually be desirable for its ability to moderate microclimate and anchor snowpacks.

As well, the growing seasons, which are short and cool, result in tree growth that is invariably slower than at low elevations. Plantation performance expectations based on low elevation experiences are not appropriate on these sites. High elevation species also exhibit slow initial height growth.

The variability of species performance is another important consideration. Highly variable stock is unreliable as a regeneration option because it is unpredictable. The preferred stock could be one with lower, but more consistent survival than a stock with higher, but more variable survival.

5.3 High Elevation Species Selection

Not surprisingly, the results of this study showed that high elevation species, although lacking the growth of low elevation species, had better survival and form planted on high elevation sites. The high elevation species were also more reliable and feasible. These results reflect the first 10 years of growth of **planted** stock only. Planted stock performance may not represent that of natural regeneration. In fact, the performance of natural Ba at these locations was generally better than that of the planted stock.

Species performance is the sum of survival, growth, form, and their interaction with management objectives. The best overall performers in this study were Se, Ba, Bl, and Bn because of consistent growth and good form. Knowledgeable selection of species and stocktypes, however, would be enhanced by information from local, exploratory trials of planted stock **and** assessment of natural regeneration performance. Both planted and natural regeneration strategies should be evaluated before a management commitment is made.

Forests at high elevations typically grow very slowly. Many of the trees in these trials are just tall enough to begin to show above the snowpack for a large part of the winter (Table 2). The relative ranking of the species performances may well change as the trees become exposed to a different winter environment. Species growth could increase or decrease, depending on the nature of the overwinter

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[5] Information can be obtained from AES for a large number of climate stations.

environment. It may not be valid to assume that those species exhibiting the best performance and least damage to date will continue to be the best performing trees in the future. Further monitoring is needed if better long-term expectations are to be developed.

Table 3 provides a ranking of the reliability and productivity of the species examined in this trial. The most conservative species prescription would be to remain with Ba, preferably using natural and advanced regeneration. Although Hm is also considered to be a preferred species (Klinka *et al.* 1984), the performance of planted stock in this study was poor compared to that of the other high elevation species. Natural regeneration may perform better. A more liberal prescription would consider the use of Se, particularly if the site had been slashburned or natural regeneration was infrequent and sparsely distributed. Although Se is exotic to much of the high elevation coast, it has been used operationally since 1969 with good results. It is probably most appropriate in the Transition and similar climates on the east coast of Vancouver Island. New areas should be tested before widespread planting is adopted.

TABLE 3. Relative species reliability and productivity for reforestation of high elevation sites using planted stock based on 10-year performance. Species are arranged in increasing order of preference in each group.

Species	Reliability	Productivity
I. Obviously off-site and unacceptable. Always a poor option!		
Cw	low: severe frost	poor
Hw	low: severe frost damage	poor
Fc	low: severe breakage	high
Lw	low: severe stem sweep	variable
Pl	low: severe stem sweep	variable
II. Questionable species. Will it become a tree?		
Hm	low: severe stem sweep	poor
Yc	low: severe stem sweep and forks	variable
III. Acceptable species.		
Bn	variable: frost damage	high
Bl	high	high
Se	high	high
Ba	high	high

A particularly enigmatic species is Yc. It is very productive wherever it was planted, although this may not be expressed as height growth. However, of all the high elevation species, Yc is most prone to form abnormalities and displays high variability. It commonly forks from the base of the stem and layers readily, particularly under the deeper, heavier coastal snowpacks. The species' performance under shallower and lighter snowpacks is encouraging but needs to be investigated further. Whether the trees will eventually produce a single, dominant leader is a matter of conjecture. We assume that Yc will eventually form a tree, but this may take a long time. Though exhibiting similar problems as Yc, Hm is not as productive a species and is best left for natural regeneration.

5.4 High Elevation Regeneration Options

Regeneration options must be matched with the severe physical environment of the site. As in low elevations, long regeneration delays following harvesting are unacceptable. The approach to selecting regeneration strategies proposed by Klinka and Feller (1984) provides some useful guidelines for developing local experience with different strategies.

A high elevation regeneration strategy should include the use of natural and advanced regeneration along with planting stock. In many cases, the best performing species might be natural and advance regeneration of Ba (Herring and Etheridge 1976). At high elevations, it is more appropriate to emphasize harvesting techniques and cutblock layouts that promote natural regeneration and preserve advance regeneration, rather than to rely solely on planting stock. Indeed, this strategy is now being implemented operationally. Smaller cutblock sizes and a block orientation that protects the regeneration from drifting

snow and high winds and that serves as a seed source may be necessary to encourage natural regeneration. Thorough reviews of using natural regeneration of Ba are given in Oliver and Kenady (1981).

Monitoring regeneration performance is a critical element in the development of local knowledge about stock suitability. Seedling mortality and damage can occur soon after planting. Plantations should be assessed early so that interpretations and recommendations can be made before expensive rehabilitation projects become necessary. If there are doubts about stock suitability, local trials should be established and the results compared to the figures presented in this report.

Our recommendations for regeneration establishment at high elevations are, in order of preference:

1. No site preparation. Rely on advance regeneration, and encourage natural regeneration.
2. No site preparation. Rely on advance and natural regeneration, and fill-plant with a preferred species and stocktype.
3. Rely entirely on planted stock of a preferred species and stocktype if no acceptable advance regeneration exists, no natural regeneration is expected, or the reforestation plan calls for a change in species composition.

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APPENDIX 1: Location summaries and maps

Variable Descriptions

Tree identification

Row	row number marked on map
Season	planting season
Spec	species abbreviation (see text)
Seed	seedlot number
Stock	stocktype

Survival

Surv	10-year row survival

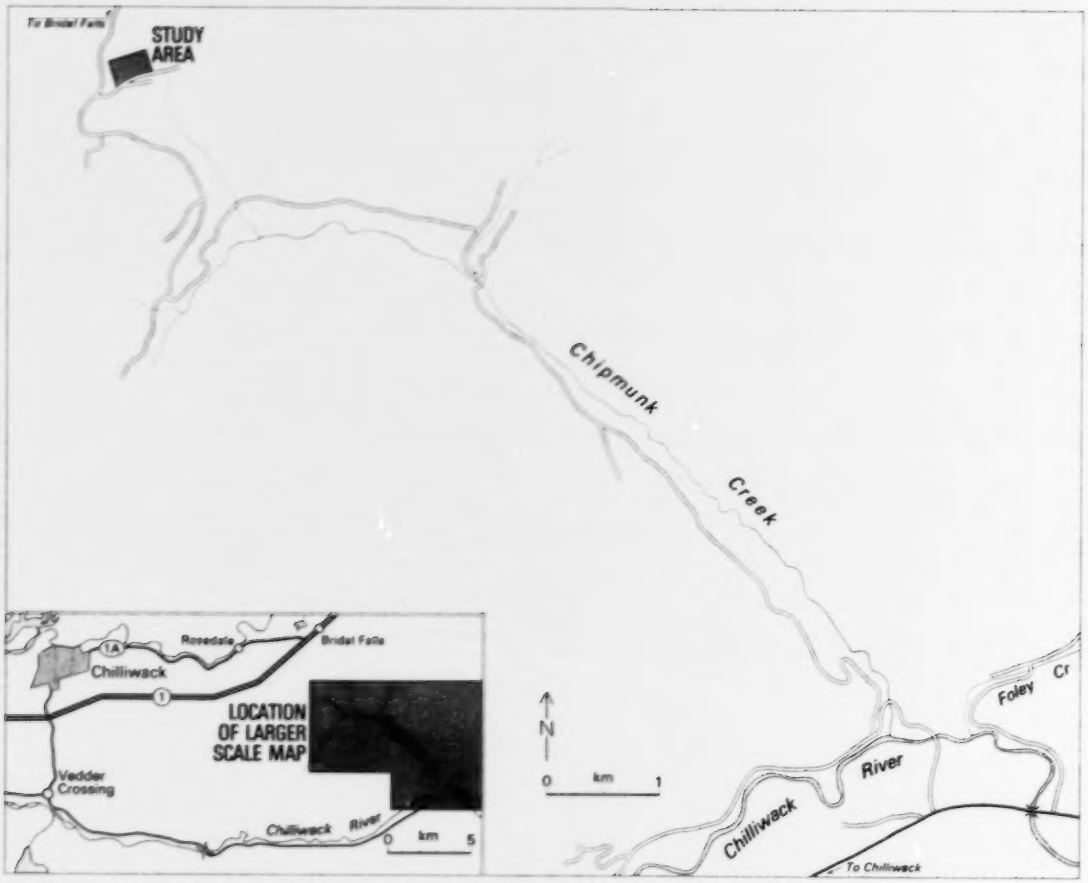
Growth

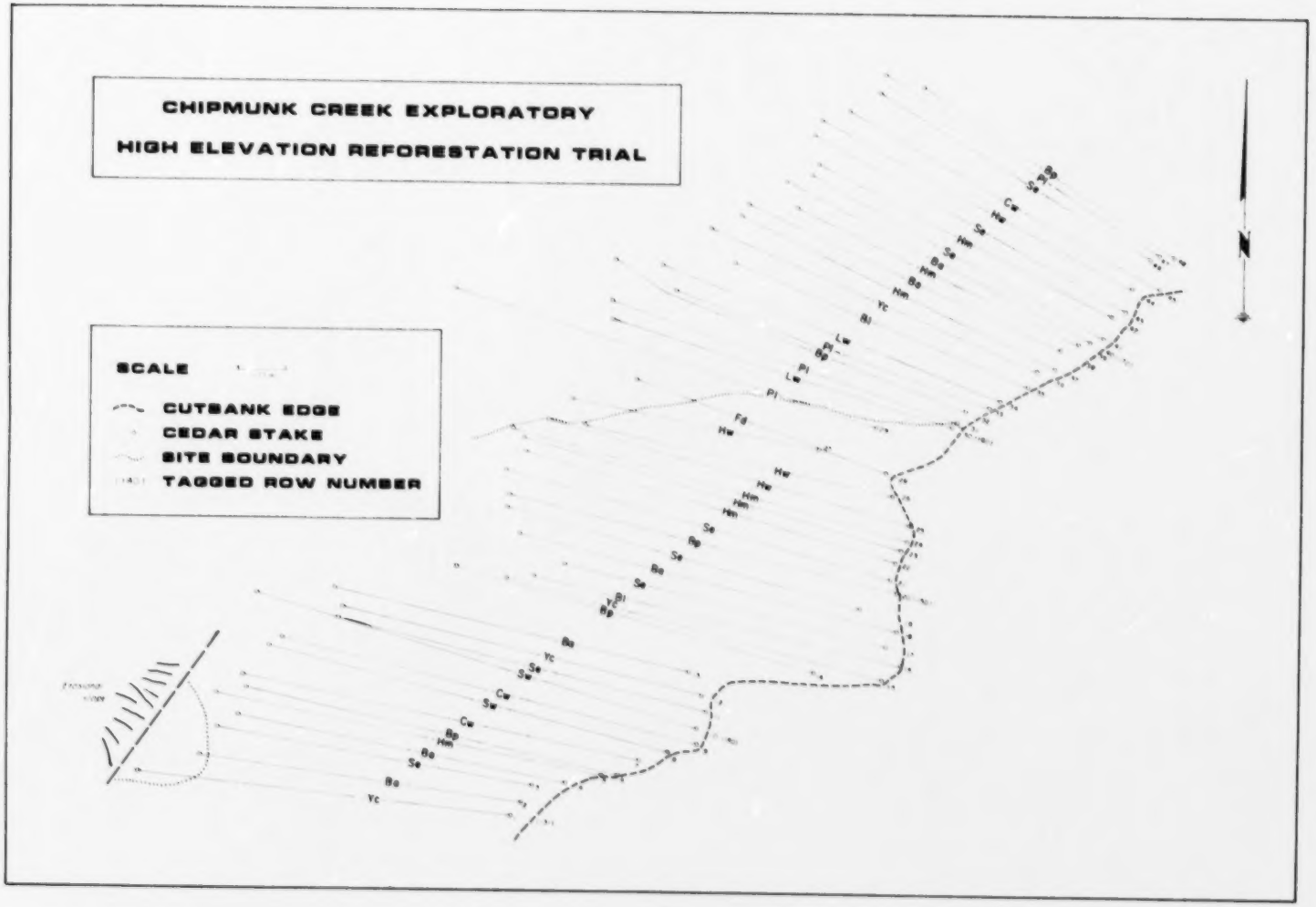
Hgt	10-year mean total height (cm)
Lead	10-year mean increment (cm; leader)
Dia	mean diameter at 30 cm (mm)
Lat	mean maximum lateral branch length (cm)

Form

Brk	frequency of stem breakage (%)
Frost	frequency of frost damage (%)
SFork	frequency of stem forking (%)
LFork	frequency of multiple leaders (%)
Sweep	frequency of severe stem sweep (%)

Chipmunk Creek

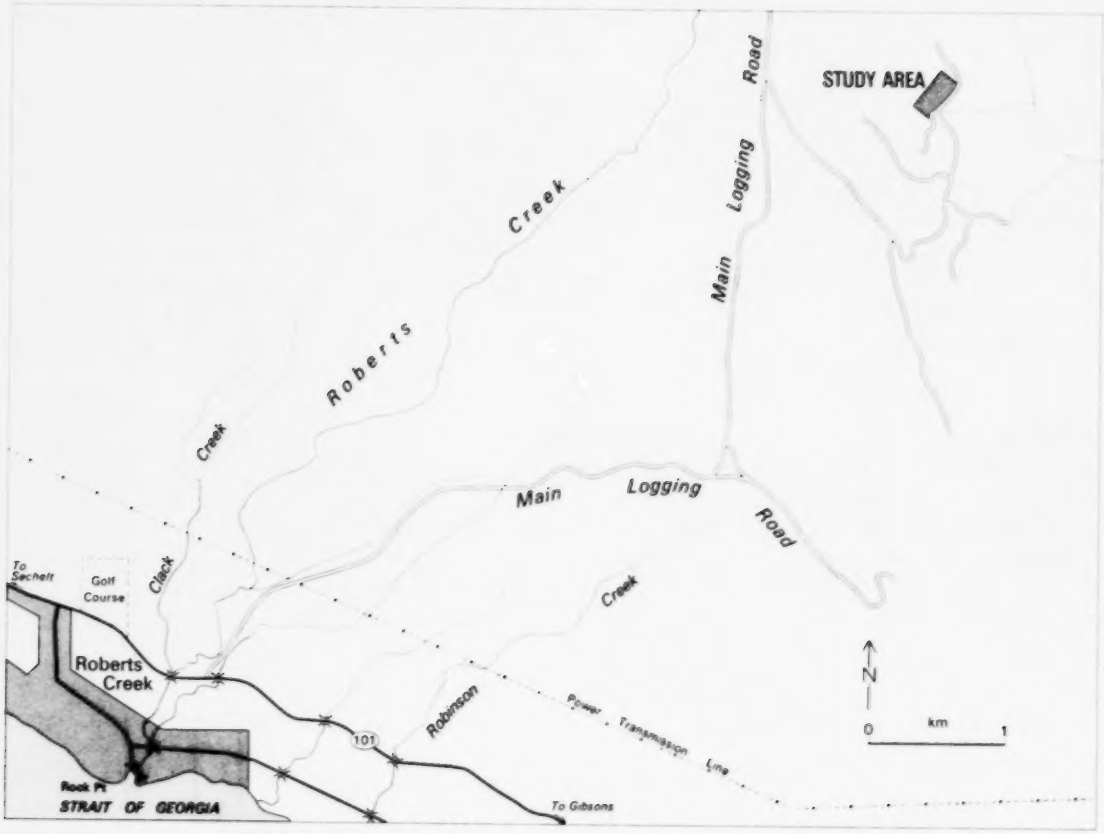


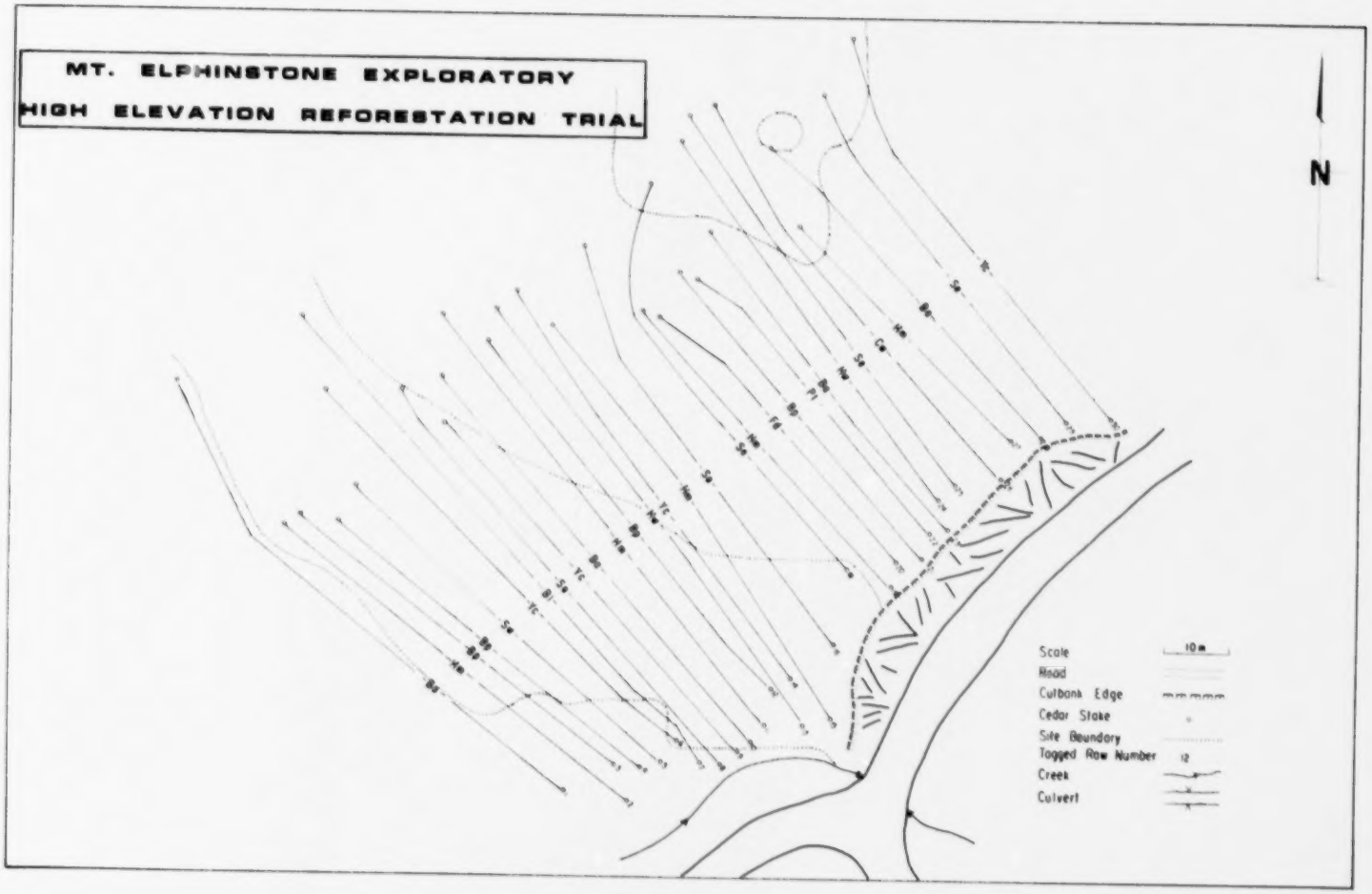

CHIPMUNK CREEK EXPLORATORY
HIGH ELEVATION REFORESTATION TRIAL
SCALE
CUTBANK EDGE
CEDAR STAKE
SITE BOUNDARY
TAGGED ROW NUMBER

Chipmunk Creek

Row	Season	Spec	Seed	Stock	Surv	Hgt	Lead	Dia	Lat	Brk	Frost	SFork	LFork	Sweep
1	Spring	Yc	TFL 26	2+0 PSB 415	88	197	30	41	87	27	9	23	0	23
2	Spring	Ba	2515	1+0 PSB 415	100	129	19	23	42	4	0	0	0	12
3	Spring	Se	1819	2+0 BR	84	185	32	37	57	5	0	10	5	5
4	Spring	Ba	2223	1+1 PBR 415	96	153	24	27	46	4	0	13	4	0
5	Spring	Hm	1097	2+1 PBR 415	96	203	23	39	78	0	13	13	13	4
6	Spring	Bn		1+1 PBR 415	96	260	35	63	77	8	0	0	0	0
7	Spring	Cw	413	2+1 BR	76	152	19	37	70	26	37	32	16	32
9	Autumn	Yc	2265	2+0 PSB 211	96	165	25	33	68	33	17	42	0	38
11	Autumn	Se	1819	2+0 BR	84	180	32	39	55	0	0	5	0	5
12	Autumn	Yc	2265	1+0 PSB 211	84	133	25	23	58	5	5	14	0	29
13	Autumn	Ba	2424	1+0 PSB 211	60	68	10	14	31	0	0	7	0	0
14	Autumn	Bn	2278	1+0 PSB 211	64	114	14	25	44	6	38	19	0	6
15	Autumn	Yc	2128	1+1 PBR 211	76	142	26	26	61	5	11	16	0	16
16	Autumn	Bl	1840	1+1 PBR 313	92	137	20	27	43	13	13	0	13	4
17	Autumn	Se	1821	1+0 PSB 313	96	173	29	39	52	13	0	8	0	8
18	Autumn	Ba	2223	1+1 PBR 415	84	173	26	35	50	5	5	5	5	5
19	Autumn	Se	1819	1+0 PSB 211	92	199	33	45	62	5	0	0	0	13
20	Autumn	Bn		1+1 PBR 415	80	185	22	50	67	0	10	5	0	10
21	Autumn	Se	wildling		100	128	19	30	43	0	0	0	0	4
22	Autumn	Hm	1097	2+1 PBR 415	100	196	22	36	74	0	12	8	56	0
23	Autumn	Hm	1915	1+0 PSB 211	84	149	22	23	54	0	10	0	24	9
24	Autumn	Hm	2480	1+0 PSB 211	68	113	16	17	43	0	18	0	0	0
25	Autumn	Hw	1095	1+0 PSB 211	64	147	24	27	53	6	63	0	44	19
26	Autumn	Hw	2476	1+0 PSB 313	44	129	23	19	50	18	18	9	18	18
27	Autumn	Hw	2476	1+0 PSB 211	52	144	21	20	57	0	31	8	0	15
28	Autumn	Fd		1+0 PSB 415	60	183	21	47	80	73	7	47	0	40
29	Autumn	Pl	1781	2+2 BR	69	263	25	67	86	22	0	11	0	67
30	Autumn	Lw	2025	1+0 PSB 415	64	155	12	21	44	0	13	19	7	44
31	Autumn	Pl	2126	1+0 PSB 211	68	208	28	41	63	18	0	6	0	47
32	Autumn	Bn	2274	1+1 PBR 211	100	171	19	40	57	8	12	12	4	0
33	Autumn	Pl	1975	1+0 BR	64	190	27	44	77	12	0	6	0	44
34	Spring	Lw	2025	1+0 PSB 415	56	159	22	22	46	7	0	64	21	43
35	Spring	Bl	1840	1+1 PBR 313	96	172	24	34	51	4	0	13	4	4
36	Spring	Yc	2265	1+0 PSB 211	96	189	31	39	81	0	8	0	0	4
37	Spring	Hm	2480	1+0 PSB 211	60	103	18	15	42	0	0	13	0	27
38	Spring	Ba	2424	1+0 PSB 211	92	119	15	21	44	4	4	4	0	0
39	Spring	Hm	2480	1+0 PSB 211	96	116	18	19	45	0	8	8	25	21
40	Spring	Ba	2258	1+1 PBR 211	100	107	16	24	48	0	4	0	4	4
41	Spring	Se	1821	1+1 PBR 211	92	178	27	40	59	0	4	9	0	0
42	Spring	Hm	1915	1+0 PSB 211	84	152	19	23	60	5	10	19	24	20
43	Spring	Se	1821	1+0 PSB 211	92	165	25	38	59	26	0	9	0	0
44	Spring	Hw	2476	1+0 PSB 313	92	222	34	33	74	4	13	13	17	4
45	Spring	Cw	1295	1+0 PSB 211	92	105	17	18	49	4	74	9	13	4
46	Spring	Se	1819	2+1 NISULA	80	173	30	42	56	0	0	10	5	0
47	Spring	Pl	2282	1+0 PSB 211	80	191	24	48	75	25	0	5	5	25
48	Spring	Bn	2278	1+0 PSB 211	100	177	26	40	62	0	32	4	4	0

Mt. Elphinstone

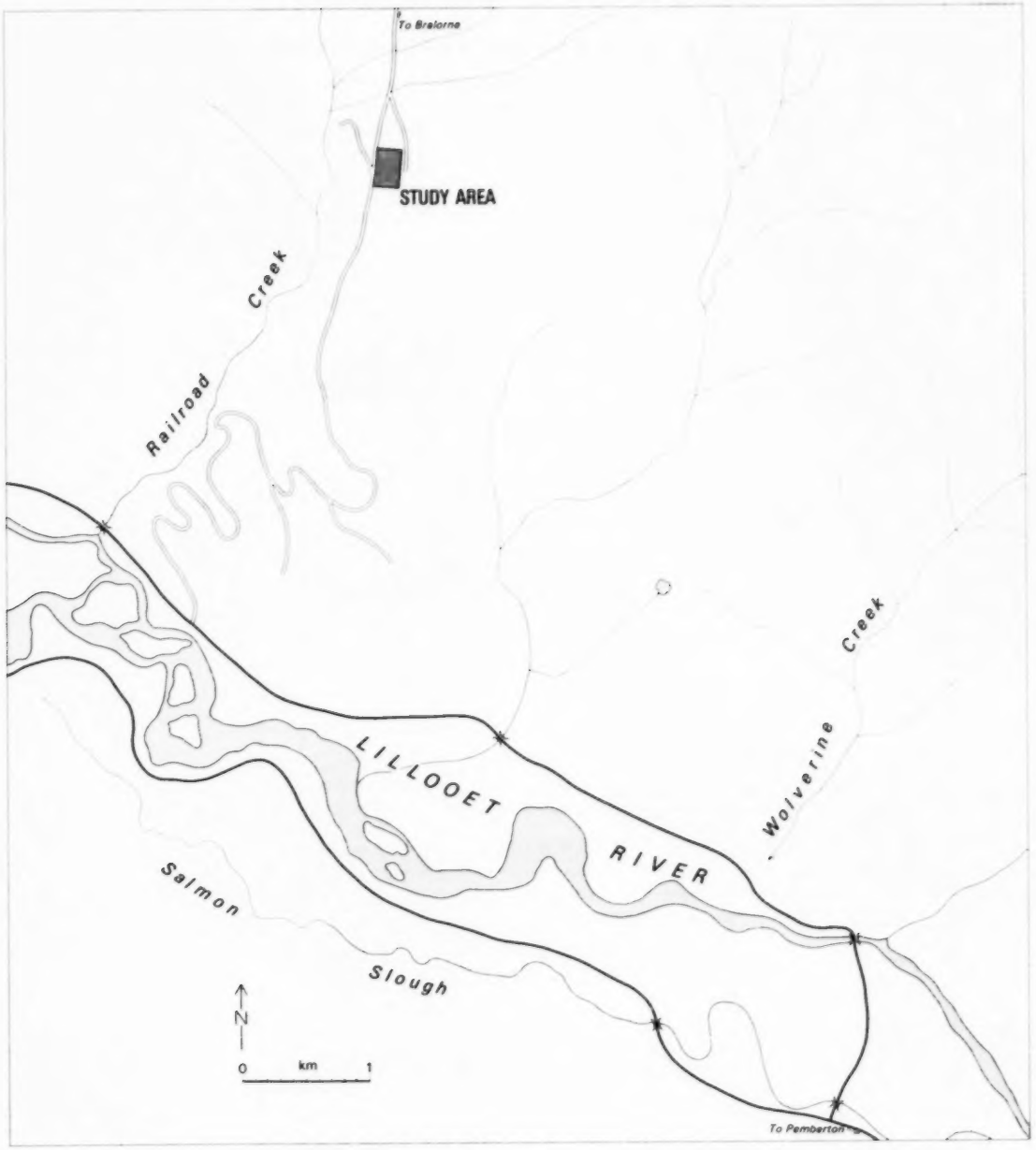


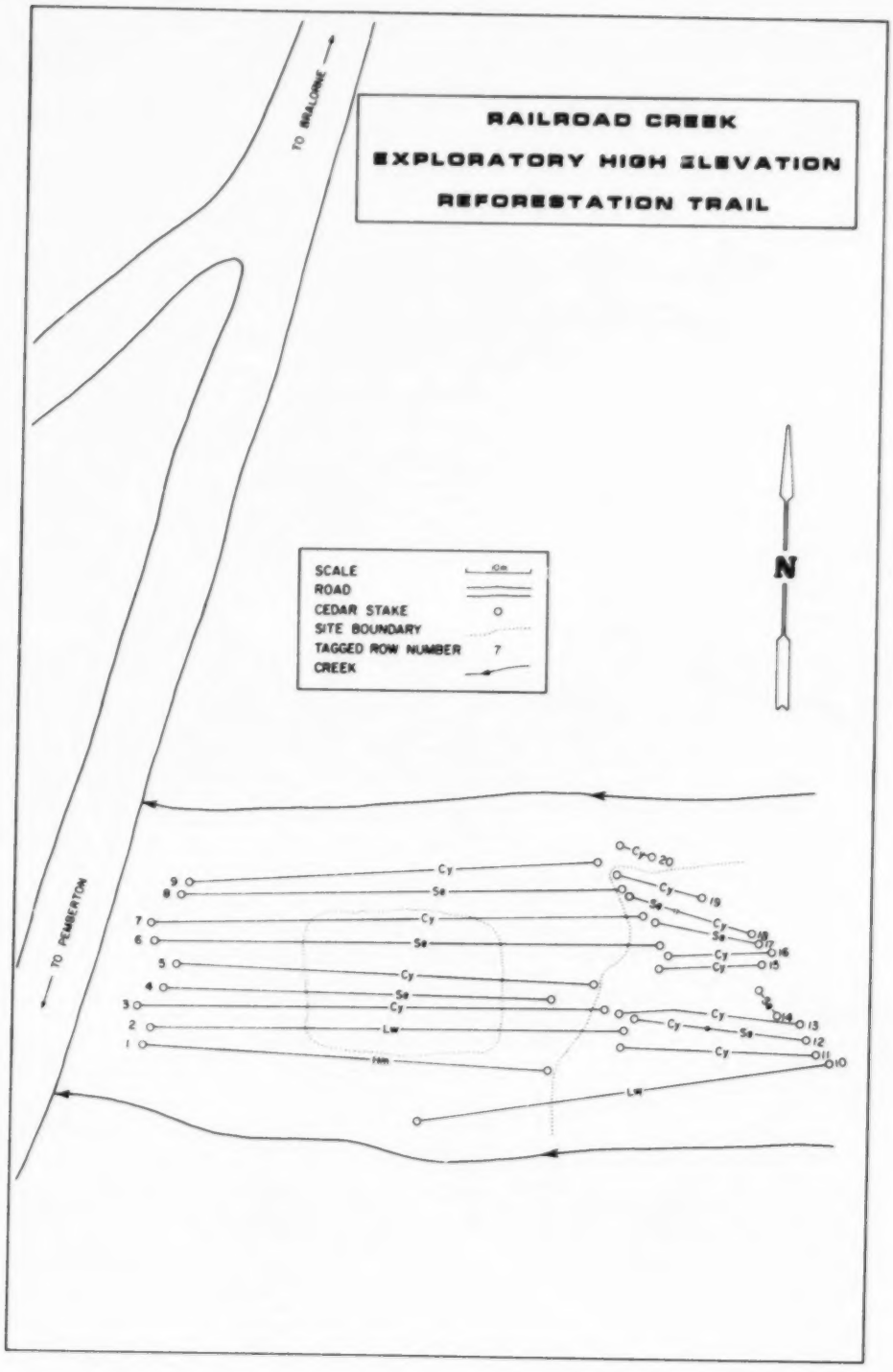

MT. ELPHINSTONE EXPLORATORY
HIGH ELEVATION REFORESTATION TRIAL
N
Scale
10 m
Road
Cutbank Edge
Cedar Stake
Site Boundary
Tagged Row Number
12
Creek
Culvert

Mt. Elphinstone

Row	Season	Spec	Seed	Stock	Surv	Hgt	Lead	Dia	Lat	Brk	Frost	SFork	LFork	Sweep
1	Autumn	Ba	2223	1+1 PBR 415	92	115	10	24	47	9	9	0	9	23
2	Autumn	Hm	1097	2+1 PBR 415	94	168	20	37	71	31	38	6	0	50
3	Autumn	Bn		1+1 PBR 415	64	198	23	39	75	0	44	11	0	0
4	Autumn	Bn		1+1 PBR 415	59	136	15	40	57	0	60	10	0	10
6	Autumn	Yc	TFL 26	2+0 PSB 415	60	138	20	23	64	7	0	27	0	7
7	Autumn	Bl	1840	1+1 PBR 313	72	154	21	30	48	0	0	11	0	17
8	Autumn	Se	I819	2+1 NISULA	76	162	25	35	52	7	0	13	7	25
9	Autumn	Yc	2128	1+1 PBR 211	64	116	21	21	51	7	13	31	0	44
10	Autumn	Ba	2424	1+0 PSB 211	80	94	11	18	43	5	5	0	10	15
11	Autumn	Hm	1915	1+0 PSB 211	96	152	25	27	68	4	25	29	0	0
12	Autumn	Bn	2278	1+0 PSB 211	56	138	19	36	54	14	29	0	0	0
13	Autumn	Hw	1095	1+0 PSB 211	76	138	14	33	66	32	58	63	32	0
14	Autumn	Yc	2265	1+0 PSB 211	46	171	25	36	88	55	0	36	9	55
15	Autumn	Hm	2480	1+0 PSB 211	72	123	21	22	53	6	11	28	11	28
16	Autumn	Se	1819	1+0 PSB 211	92	219	40	47	71	4	0	30	0	4
18	Autumn	Se	1821	1+0 PSB 313	96	182	30	38	65	4	4	17	0	0
19	Autumn	Hw	2476	1+0 PSB 211	76	150	19	27	71	5	16	32	16	5
20	Autumn	Fd		1+0 PSB 415	60	123	14	29	68	43	71	60	14	20
21	Spring	Bn	2278	1+0 PSB 211	92	196	28	47	73	4	52	0	4	0
22	Spring	Pl	2282	1+0 PSB 211	91	213	31	48	79	0	29	19	5	5
23	Spring	Ba	2424	1+0 PSB 211	88	100	17	17	40	5	9	5	0	5
24	Spring	Hw	2476	1+0 PSB 313	56	153	22	27	63	7	29	50	43	7
25	Spring	Se	1821	1+0 PSB 313	100	196	36	45	71	0	25	25	4	0
26	Spring	Cw	1295	1+0 PSB 211	62	89	15	12	55	0	6	44	0	44
27	Spring	Hm	1915	1+0 PSB 211	92	154	29	28	73	0	12	41	41	24
28	Spring	Ba	2512	1+0 PSB 415	72	156	30	31	53	0	72	28	6	0
29	Spring	Se	1819	2+0 BR	88	184	35	47	64	0	23	27	0	5
30	Spring	Yc	TFL 26	2+0 PSB 415	88	161	21	32	83	36	32	68	5	36

Railroad Creek

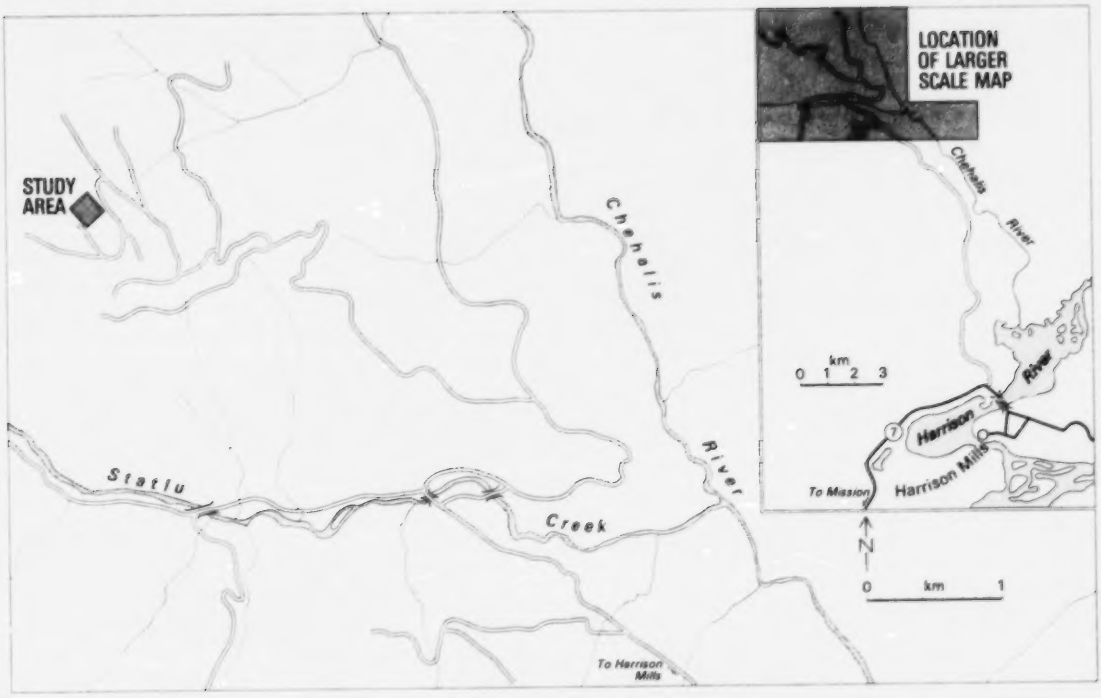


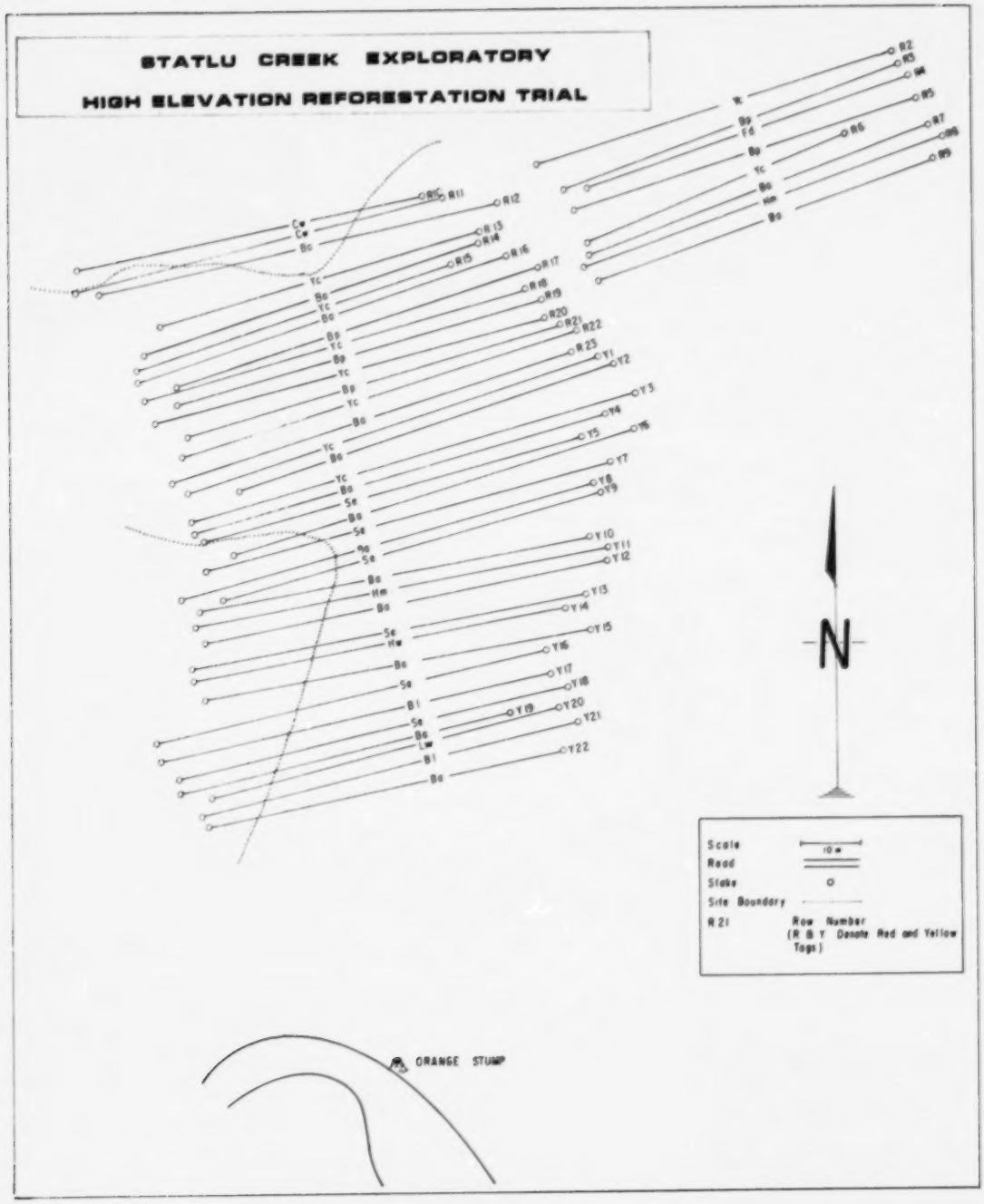

RAILROAD CREEK
EXPLORATORY HIGH ELEVATION
REFORESTATION TRAIL
TO BRALORNE
TO PEMBERTON
SCALE
ROAD
CEDAR STAKE
SITE BOUNDARY
TAGGED ROW NUMBER
CREEK
N
Cy
Se
Lw
Hm

Railroad Creek

Row	Season	Spec	Seed	Stock	Surv	Hgt	Lead	Dia	Lat	Brk	Frost	SFork	LFork	Sweep
1	Autumn	Hm	2368	1+0 PSB 415	92	131	13	22	49	4	0	9	0	9
2	Autumn	Lw	2025	1+1 PBR 415	80	308	45	53	83	10	0	60	5	5
3	Autumn	Yc	2426	1+0 PSB 211	96	171	30	26	82	4	0	17	0	4
4	Autumn	Se	1821	1+0 PSB 211	72	157	13	33	57	17	0	0	11	28
5	Autumn	Yc	2426	2+0	52	207	31	28	96	8	0	0	0	0
6	Autumn	Se	2363	2+0	88	143	13	30	48	0	0	5	0	9
7	Autumn	Yc	2426	1+0	68	165	30	28	82	0	0	6	6	0
8	Autumn	Se	1819	2+1	100	159	16	35	56	0	0	0	0	0
9	Autumn	Yc	2436	1+1 PBR 211	100	243	34	42	109	8	0	8	0	0
10	Spring	Lw	2025	1+1 PBR 415	76	250	38	44	73	21	0	53	5	5
11	Spring	Yc	2426	1+0	59	161	28	24	76	29	0	0	0	0
12	Spring	Yc	2426	1+0	83	177	24	34	67	0	0	10	0	0
13	Spring	Yc	2426	1+0	69	164	14	37	59	0	0	0	0	0
14	Spring	Se	2363	2+0	72	174	19	39	70	0	0	33	0	0
15	Spring	Yc	2426	1+1 PBR 211	88	173	31	71	80	29	0	43	0	0
16	Spring	Yc	2426	1+1 PBR 211	83	150	23	24	73	7	7	33	0	0
17	Spring	Se	1821	1+0 PSB 211	71	131	12	30	51	0	0	25	0	8
18	Spring	Se	1821	1+0 PSB 211	100	151	19	26	61	6	0	18	6	6
19	Spring	Yc	2426	1+0 PSB 211	100	141	21	22	58	11	11	33	0	0
20	Spring	Yc	2426	1+0 PSB 211	100	158	28	23	73	0	0	33	0	0

Statlu Creek




STATLU CREEK EXPLORATORY
HIGH ELEVATION REFORESTATION TRIAL
N
Scale
10 m
Road
Stake
Site Boundary
R 21
Row Number
(R & Y Denote Red and Yellow Tags)
ORANGE STUMP

Statlu Creek

Row	Season	Spec	Seed	Stock	Surv	Hgt	Lead	Dia	Lat	Brk	Frost	SFork	LFork	Sweep
R1	Autumn	Bn	2875	1+0 PSB 415	92	194	27	52	80	4	0	0	0	8
R2	Autumn	Yc	TFL 26	1+0 CRC	84	222	27	37	78	5	5	38	5	5
R3	Autumn	Bn	2875	1+0 PSB 313	88	199	28	45	69	0	0	0	0	23
R4	Autumn	Fc	1019	1+0 PSB	40	176	29	30	64	40	30	20	0	30
R5	Autumn	Bn	2875	1+0 PSB 211	96	190	31	45	72	4	0	4	0	13
R6	Autumn	Yc	2426	1+0	24	146	21	25	66	20	20	20	0	0
R7	Autumn	Ba	2223	2+0	92	146	18	25	51	0	0	4	0	4
R8	Autumn	Hm	2368	1+0 PSB 415	100	182	22	36	64	0	0	20	20	20
R9	Autumn	Ba	2223	1+1	72	167	19	27	48	0	0	0	0	6
R10	Spring	Cw	2646	1+0 PSL 412	40	135	12	33	61	70	90	60	50	35
R11	Spring	Cw	413	1+0 PSB 211	80	121	13	27	68	40	95	90	50	30
R12	Spring	Ba	2223	2+0	88	148	21	26	51	0	0	32	0	5
R13	Spring	Yc	2426	2+0	100	192	21	31	81	72	48	16	16	0
R14	Spring	Ba	2223	1+1	100	148	20	28	57	4	0	0	0	8
R15	Spring	Yc	2426	1+1 PBR 211	100	175	22	31	77	68	24	48	8	4
R16	Spring	Ba	2512	1+1 PBR 415	100	210	28	45	70	0	0	4	0	12
R17	Spring	Bn	2875	1+0 PSB 211	100	208	31	54	81	8	0	0	0	16
R18	Spring	Yc	2426	1+0 PSB 211	100	166	21	32	48	16	96	28	4	4
R19	Spring	Bn	2875	1+0 PSB 313	92	215	34	56	81	13	0	4	0	0
R20	Spring	Yc	2426	1+0	100	170	24	29	71	52	32	28	12	0
R21	Spring	Bn	2875	1+0 PSB 415	96	259	38	66	94	13	0	0	0	13
R22	Spring	Yc	2426	1+0 MP	92	164	23	30	82	44	35	22	0	0
R23	Spring	Ba	2223	2+0 MP	88	152	21	28	53	9	0	5	0	0
Y1	Autumn	Yc	2426	1+1	92	198	26	38	90	26	0	44	17	0
Y2	Autumn	Ba	2223	1+1	88	159	29	30	59	5	9	5	0	0
Y3	Autumn	Yc	2426	1+1	100	187	29	36	81	32	0	60	12	4
Y4	Autumn	Ba	2677	1+1 Nisula	84	155	30	30	59	0	0	5	0	0
Y5	Autumn	Se	1815	2+0	92	138	28	30	58	35	0	48	0	17
Y6	Autumn	Ba	2512	3+0	100	193	27	36	64	0	0	0	0	0
Y7	Autumn	Se	1819	2+1	100	213	39	59	77	24	0	16	0	4
Y8	Autumn	Ba	2223	2+1	92	164	26	37	64	0	0	9	4	0
Y9	Autumn	Se	1821	11/2+11/2	96	168	31	44	59	13	0	8	8	4
Y10	Autumn	Ba	2512	2+1 Nisula	92	155	29	34	59	9	0	0	0	0
Y11	Autumn	Hm	2403	1+0 PSB 415	44	119	21	22	51	0	6	47	77	12
Y12	Autumn	Ba	2223	1+2	96	172	29	35	60	0	0	0	8	0
Y13	Autumn	Se	1819	1+0	96	174	33	41	60	8	0	8	8	0
Y14	Autumn	Hw	3011	1+0	92	155	32	39	83	70	78	61	74	0
Y15	Autumn	Ba	2995	1+0	96	143	26	31	54	0	0	13	4	0
Y16	Autumn	Se	1821	1+0	100	141	28	35	49	8	4	8	0	0
Y17	Autumn	Bl	2900	1+0	92	157	31	45	58	17	0	4	26	0
Y18	Autumn	Se	1819	1+0	92	129	27	31	46	4	0	0	13	0
Y19	Autumn	Ba	2677	2+0	96	138	26	28	58	13	0	0	4	4
Y20	Spring	Lw	2025	1+0 mudpack	44	163	29	28	55	18	0	100	27	46
Y21	Spring	Bl	2680	2+0 mudpack	84	176	40	40	65	24	0	10	10	5
Y22	Spring	Ba	2677	2+0 mudpack	84	129	26	27	56	10	0	10	10	5

Appendix 2. Location ecological descriptions

CHIPMUNK CREEK

History

The original stand included Ba, and Hw, with a minor component of Cw, with approximately 250 stems per hectare and diameters up to 170 cm. Logging occurred in 1959, followed by slashburning in 1960 and 1962. The area was first planted in October of 1963 with Fd (2+0 BR, seedlot 414). Survival was 5%. Average height of these trees in 1975 was 210 cm. A second planting took place in 1969 using Fd (2+0 BR, seedlot 1270). Survival was 56%, with an average height of 90 cm in 1975. The high elevation trial was planted in 1975 (fall) and 1976 (spring). A total of 1375 trees were planted, comprising 14 species and 20 stocktypes. Ninety-nine percent of the trees were planted in mineral soil.

Site description

Biogeoclimatic unit:	Upper elevational range of CWHb5 variant; 1200 m elevation.
Topography:	Upper macroslope, SE aspect.
Soil parent material:	Morainal blanket; derived from base-rich, fine-grained metamorphic (e.g., phyllite, hornfel) bedrock.

Site stratification

Two different strata were recognized and are shown on the layout map (Appendix 1). Strata 1 in the southern portion of the trial is characterized by a gentler slope gradient, while Strata 2 is on steeper terrain.

Both strata were dominated by herbaceous species, particularly early colonizers which invade disturbed sites (e.g., *Epilobium angustifolium*, *Anaphalis margaritacea*). The majority of species were indicative of medium to rich nutrient regimes. Nutrient-poor to medium indicators such as *Clintonia uniflora* and *Rubus pedatus* generally occurred on thick forest floors.

Strata 1 is characterized by later snowmelt in the spring relative to Strata 2, and probably greater snow accumulation. This may affect variation in tree form associated with snow deformation.

Strata 1

Edatope:	4-5/D (fresh to moist/nutrient-rich).
Topography:	20% slope; middle- to lower-slope position.
Soil:	Deep (>1 m), moderately well-drained soil; loam texture with approximately 10-20% coarse fragment content in upper (40 cm) portion changing to loamy sand with 30-40% coarse fragment content below. Compact basal till below 80 cm impedes downward movement of water. Thin, discontinuous Ae horizon; forest floor averages 10 cm in thickness.

Strata 2

Edatope:	4/D (fresh, nutrient-rich; slightly drier along upper portion of slope).
Topography:	35-40% slope, mid- to upper-slope position.
Soil:	Deep (>1 m), well-drained soil; loam texture with approximately 10-30% coarse fragment content in upper (40 cm) portion, increasing to 40-50% coarse fragment content below. Soil is friable through at least 100 cm. Well-developed Ae horizon; forest floor averages 10 cm in thickness.

MT. ELPHINSTONE

History

The original stand was composed of Ba and Hm. Logging took place in 1963 over a 250 ha opening, and was slashburned in the fall of that year. The area was planted in the fall of 1966 using Fd (2+0 BR); survival was 6%. The species trial was planted in fall 1975 and spring 1976, with 91% of seedlings planted in thick humus which covered the area. Dense *Vaccinium* clumps interfered with planting site selection. A total of 710 trees were planted, comprising 11 species and 12 stocktypes.

Site description

Biogeoclimatic unit: MHa subzone; 1130 m elevation.

Topography: Upper macroslope; S - SE aspect.

Soil parent material: Morainal blanket to veneer derived from fractured meta-volcanic and granitic bedrock (base-medium).

Vegetation: The plantation was dominated by a dense, thicket-like cover of *Vaccinium* species. An adjacent mature stand on a 4/D edatope is representative of a Ba - Hm - *Vaccinium* (oval., memb., & alask.) - *Rhytidiopsis robusta* plant community.

Site Stratification:

Four strata were recognized and shown on the layout map (Appendix 1). Strata 1 represents the flat terrain adjacent to a small creek in the extreme SW end of the trial. Strata 2 includes the gentle slope adjacent to Strata 1. Strata 3 includes the steeper slope that dominates the NE half of the trial above Strata 2. Finally, Strata 4 encompasses shallow soils at the ridge crest in the N corner of the trial.

Although strata differ somewhat in edatope (mainly moisture regime), this in itself is not likely to have the greatest effect on regeneration performance, since moisture is not limiting on any of these sites. More important is physiography, which affects exposure and snow accumulation and ablation patterns. Strata 1 is characterized by late snowmelt and probably greater snow accumulation. Stratas 3 and 4 appear to be more exposed to wind/ice damage. These microclimatic differences have the potential to influence regeneration growth and, more particularly, form.

Strata 1

Edatope: 5(-6)/C.

Topography: Flat; lower-slope position.

Soil: Imperfectly drained; loam texture with 35% coarse fragments in upper 20 cm, over a very dense, gravelly sandy loam layer with 70-85% coarse fragment content. This dense layer is 30-40 cm thick, over a more friable layer containing seepage water. Well-developed Ae; forest floor 15 cm thick. Rooting does not extend beyond 20 cm into the mineral soil. Total rooting depth, including forest floor, is 30 cm.

Strata 2

Edatope: 4(-5)/B-C.

Topography: 20% slope; mid-slope position.

Soil: Loam texture with 35% coarse fragment content in upper 30 cm, over a very dense, gravelly sandy loam with 70-80% coarse fragment content. Temporary lateral seepage occurs above the dense layer, compensating for the shallow rooting depth. Total rooting depth, including the forest floor, is 30 cm. Well-developed Ae present; forest floor is 10 cm thick.

Mt. Elphinstone (Continued)

Strata 3

Edatope: 4/B-C.

Topography: 45% slope; mid-slope position.

Soil: Similar to Strata 2 with slightly deeper rooting depth (50 cm, including forest floor). Soils appear slightly better drained, with less lateral seepage. Forest floor is 16 cm thick.

Strata 4

Edatope: 2/B-C.

Topography: Variable slope; ridge crest.

Soil: Shallow morainal veneer over bedrock; frequent rock outcrops. Soil depth averages 30-40 cm, but is quite variable; deeper pockets in swales are wetter and feature late snowmelt.

RAILROAD CREEK

History

The original stand was composed of Cw, Hw, Ba, and Yc. Logging took place in 1975 and the setting was slashburned in 1976. The trial was planted in the fall of 1976 and spring of 1977. An operational plantation of Se was established in the fall of 1977. In total, 500 trees comprising four species and 8 stocktypes were planted.

Site description

Biogeoclimatic unit: Upper elevational range of CWHb5 variant transitional to ESSFf, 1100 m elevation.

Topography: Middle macroslope; W aspect.

Soil parent material: Morainal blanket to veneer with colluviated surface materials on steeper sections; derived from granitic (quartz diorite) and volcanic (andesite, rhyolite) bedrock (base-poor to medium).

Vegetation: The submaritime influence is indicated by *Paxistima, Ribes lacustre*, and *Acer glabrum* in the understory, and Bl in the adjacent mature stand. The occurence of Fd in these stands at higher elevations is also characteristic of wetter submaritime CWH climates. An adjacent mature stand to the north of the trial represents a Ba - Bl - (Cw,Fd) - *Vaccinium membranaceum - Paxistima myrsinites - Rhytidiopsis robusta* plant community.

Site Stratification:

Climate is less harsh than on the other trial sites; the physiography is a mid-slope in an upper valley, which is oriented to the south into the Lillooet River valley. All other sites are exposed upper ridges. In addition, the steeper slope results in more stem deformation from snow creep; however, generally lower density snow in the more transitional climate results in less snow press damage.

Two strata were recognized and are shown on the trial layout map (Appendix 1). Strata 1 is the major site that represents the steep slope in the eastern portion of the trial. This slope breaks to a slightly gentler, convex-shaped site which characterizes the upper portion where rows 11-19 are located (Strata 2). A section of shallower colluvial soils with rock outcrops occurred within Strata 1 (indicated in map). The shallow soil was compensated by seepage off the exposed rock and did not appear to differ notably from Strata 1.

Strata 1

Edatope: 4(-5)/C(D).

Slope: 70% slope; mid-slope position.

Soil: Well-drained, deep, sandy loam-textured soil with 50-60% coarse fragment content. The upper portion (30-40 cm) is a very loose and porous colluvial veneer which shows signs of active downslope movement. The soil is friable and well aerated through at least 1 m; temporary seepage likely occurs at depth. Rooting is well developed through 80 cm; the forest floor is 10 cm thick (originally Mor but "activated" by increased heat and light from clearcutting).

Strata 2

Edatope: 3/C.

Slope: 55% slope; convex-shaped upper-slope position.

Soil: Well-drained, deep, sandy loam-textured soil with 30-40% coarse fragment content; changing to coarser texture (loamy sand) in the lower portion. The soil is friable, with well-developed roots through 85 cm. The forest floor is thin (4 cm) with some mineral soil exposed, reflecting surface erosion and the impact of slashburning.

STATLU CREEK

History

The original stand included Hm, Hw, and Ba with minor Yc. The block was logged and slashburned in 1975, followed by planting of the species trial in fall and spring of 1976 and 1977, respectively. A total of 1125 trees, comprising 9 species and 17 stocktypes, were planted. Over the years, Hw, Ba, Yc, and Fc have been operationally planted and there has been abundant natural seeding by Yc.

Site description

Biogeoclimatic unit: MHa (lower limits); 1050 m elevation.

Topography: Upper macroslope; E aspect.

Soil parent material: Morainal blanket derived from mixed granitic (quartz diorite) and volcanic (andesite, rhyolite) bedrock (base-poor to medium).

Vegetation: An adjacent mature stand on a site similar to Strata 1 represents an Hm - Ba - (Yc) - *Vaccinium* (*ovalifolium, alaskaense,* & *membranaceum*) - *Rhytidiopsis robusta* plant community.

Site Stratification:

One basic site dominates the trial area (Strata 1); however, a slightly drier and more heavily disturbed strata (Strata 2) was recognized in the southwest corner. A localized, moister, shallow draw occurred in association with the last two rows in the north end of the trial.

Strata 1

Edatope: 4/(B-)C.

Slope: 20% slope.

Soil: Deep, moderately well-drained, loam-textured soil with 35% coarse fragment content. Soil friable through 100 cm. Rooting depth is 40 cm. Well-developed Ae horizon; forest floor is 10 cm thick (originally Mor but "activated" by increased heat and light from clearcutting).

Strata 2

Edatope: 3/(B-)C.

Slope: 20% slope.

Soil: Moderately well-drained, loam textured soil with 10-15% coarse fragment content in upper 40 cm; underlying soil has high (70%) coarse fragment content and impedes rooting. A thin forest floor (2 cm) and mixed surface mineral layer are characteristic of logging/burning-related disturbance. Total rooting depth is 40 cm.